INSTRUCTION MANUAL

M501A

SLB DIA MEASURING SYSTEM

Anritsu

WARRANTY

All Anritsu instruments are warranted against defective material and workmanship. This warranty applies for one year from the date of delivery to original purchaser.

Anritsu will repair or replace products which will prove to be defective during the warranty period provided they are returned to Anritsu. Any questions for instruments and their service should be directed to Anritsu or representative in your area.

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POWER REQUIREMENT

The instrument requires a power source of the marked voltage in the table below. Please read this manual changing the power requirement to the designated voltage.

The line fuse had replaced according to the line voltage to be used.

Power Requirement (volt)	100	115	220	240
Line Fuse (A)				
Rear Panel 2		(2)	1	
Rear Panel 4		(1)	0.5	

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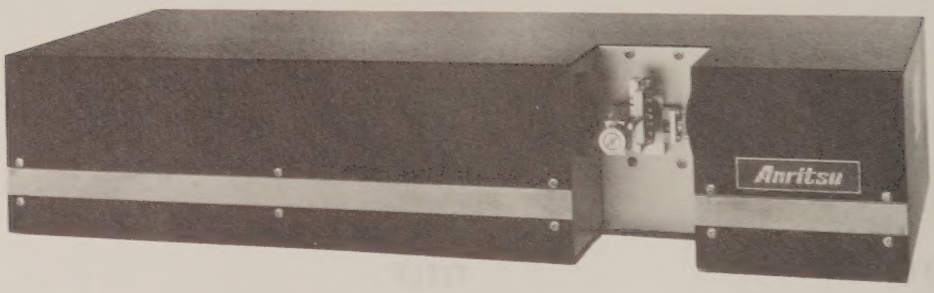


OPTICAL UNIT

PROCESSING UNIT

Fig. 1-1 M501A SLB DIA MEASURING SYSTEM with Supplied Accessories

SECTION 1

GENERAL INFORMATION

1.1 Introduction

The type M501A SLB DIA-MEASURING SYSTEM is designed to measure diameters of glass fibers or wires of various material. The instrument is composed of an OPTICAL UNIT and a PROCESSING UNIT. In the OPTICAL UNIT a vibrating laser beam from the optical scanner searches the object and photo-electric signal are obtained. In the PROCESSING UNIT, the diameter of the object is precisely determined using the photo-electric signals.

The instrument has the following features:

(1) The non-contacting and reversible scanning method, using a vibrating mirror at the top of the tunning fork, allows accurate and stable measurement of moving objects.
(2) The scanning rate of the laser beam is 1,000 scans/sec and the analog signal of the measured diameter is filtered out through 100 Hz low pass filter.
(3) The measurement of outside diameters is not affected by the fact that the object is transparent or opaque.
(4) The accuracy is maintained even if the object moves within the measuring area.
(5) Diameters are digitally displayed and deviations from a nominal diameter are available in the form of analog voltages.
(6) The instrument can easily be calibrated using the two standard wires provided.
(7) The influences of ambient light and intensity variations of the laser are negligible. Sufficient stabilization is also provided to prevent the drift resulting from temperature changes.
(8) The position of the object can be two-dimentionally monitored during the measurement of diameter.

The instrument will perform to the specifications listed in this section in a usual environment, with ambient temperature range between 0°C and +40°C.

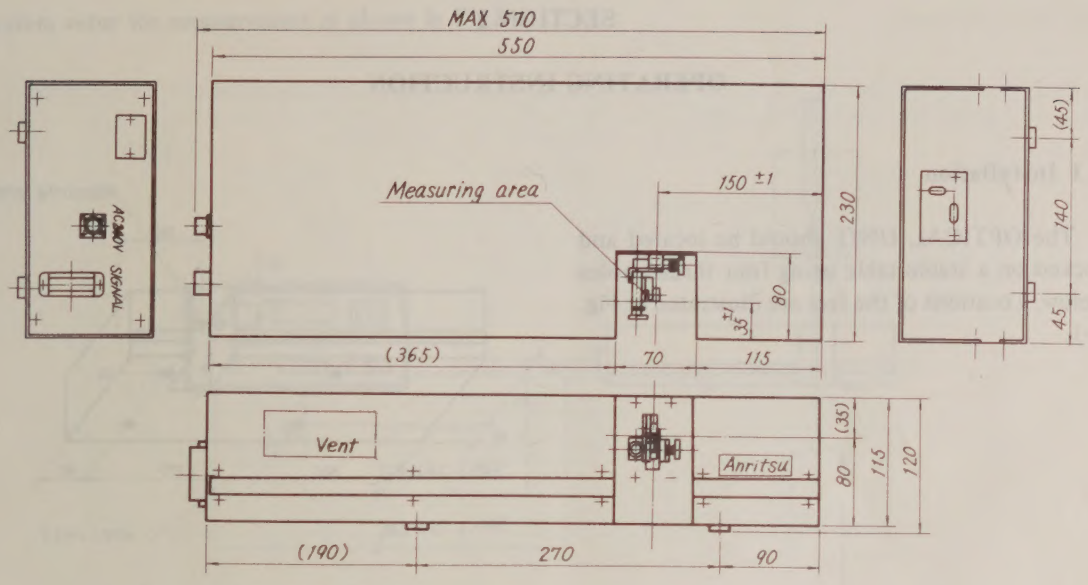
1.2 Composition

The system consists of the following (See Fig. 1-1).

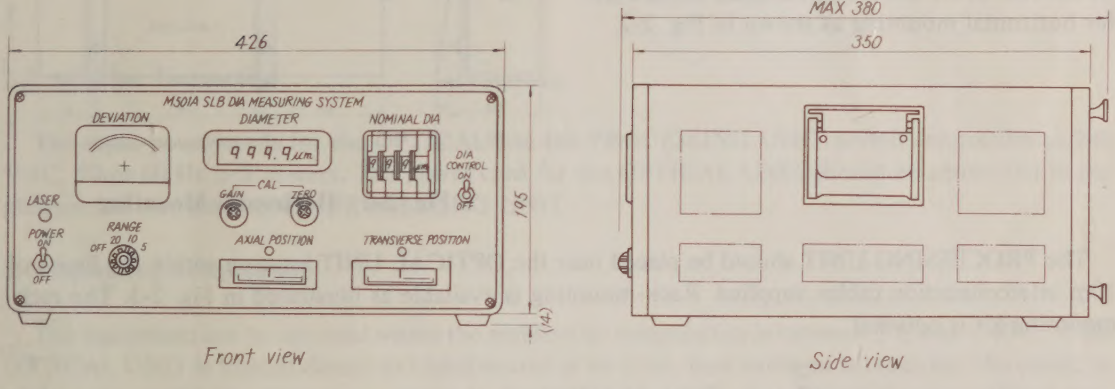
(1) OPTICAL UNIT 1
(2) PROCESSING UNIT 1
(3) Accessories and spares
  (a) Connection cables
    (a-1) For 240VAC power for PROCESSING UNIT, 2.5m 1
    (a-2) For 240VAC power between OPTICAL and PROCESSING UNIT, 10m 1
    (a-3) For photo-electric signal between OPTICAL and PROCESSING UNIT, 10m 1
  (b) Output connectors
    (b-1) For CONTROL 1
    (b-2) For DATA OUT 1
    (b-3) For ALARM 1
  (c) Fuses
    (c-1) For laser power supply 4
    (c-2) For PROCESSING UNIT 4
  (d) Standard wires for calibration 3
(4) Instruction manual 1
(5) Test certificate 1
(6) Options 1
  (a) M436C HIGH-LOW UNIT 1
  (b) Rack mounting kit 1
  (c) Horizontal mounting kit 1

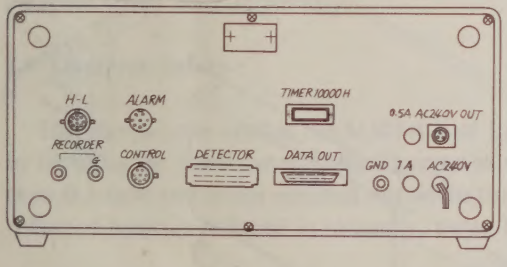
1.3 Specifications

Scanning beam orientation	Horizontal
Measuring range	50.0 to 999.9 μm
Measuring area	2 mm × 2 mm
Stability (during 10 hours, within ±5°C)	± 0.0125% of reading ± 0.2μm
Repeatability (1) Along the laser beam direction (2) Along the direction of scanning	 ± 0.3 μm ± 0.3 μm
Linearity	± 0.5 μm
Measuring rate	1,000 scans/sec
Nominal diameter	0 to 999 μm by three digit digital switch
Indications (1) Outside diameter (2) Deviation from the nominal diameter (3) Object position (3) Monitor lamps	 4-digit, LED Rate: 0.1 sec 3-step selectable meter, Ranges: ± 5 μm, 10 μm, 20 μm Meter accuracy: ± 2.5% Two dimentionally by the two meters, Range: Laser beam direction (AXIAL), ± 1 mm Scanning direction (TRANS), ± 1 mm Three LED lamps for object positions and the laser power. When they are normal, the lamps light reddish
Electrical signal output (1) Analog deviation (2) Digital output (3) Object position (4) Alarm output	 Output levels: i) 10 mV/1 μm (MAX ± 10~15V) ii) 500 mV/1 μm (Saturation level: ± 4.5 ± 0.5V) Deviation error: ± (0.2% of reading + 0.02% of diameter) Output impedance: $\leq$1Ω (DC) Current capacity: 5 mA (Output level: ± 5V) Output filter: 100 Hz (−3dB) LPF BCD code, Positive logic, TTL open collector Two dimentional analog outputs, Output level: ∓ 5V/ ± 1 mm Accuracy: AXIAL, ± 20% TRANS, ± 5% Output impedance: $\leq$5Ω Current capacity: 5 mA Output filter: AXIAL, 80 Hz (−3 dB) LPF TRANS, 1 kHz (−3 dB) LPF Relay make contact, 200V AC, 1A, i) Object position ii) Laser power
Operating temperature	0 to +40°C
Warm-up time	30 minutes maximum
Power requirement	240V AC ± 10%, 50/60 Hz, less than 150VA
Dimentions and weight (1) OPTICAL UNIT (2) PROCESSING UNIT	 120 mm high, 230 mm wide, 550 mm long, < 14 kg 195 mm high, 426 mm wide, 350 mm deep, < 12 kg



OPTICAL UNIT





PROCESSING UNIT

Fig. 1-2 M501A Outline Drawing

SECTION 2

OPERATING INSTRUCTION

2.1 Installation

The OPTICAL UNIT should be located and locked on a stable table using four thread holes below. Locations of the feet are illustrated in Fig. 2-1.

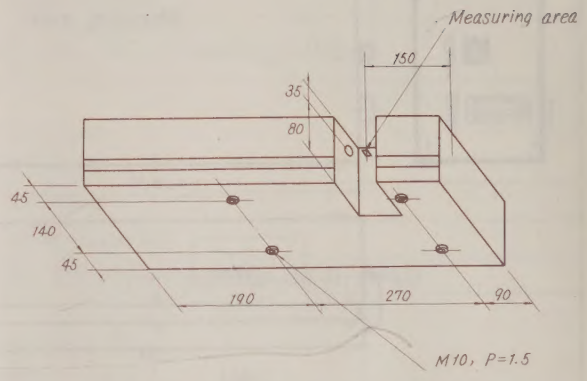


Fig. 2-1 Locations of Feet

When the object runs parallel to vertical line, the OPTICAL UNIT is installed normally. When the object runs parallel to a horizontal plane, the OPTICAL UNIT should be installed using a kit for horizontal mounting as shown in Fig. 2-2.

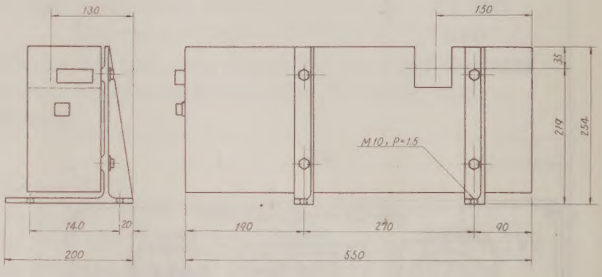


Fig. 2-2 Horizontal Mounting

The PROCESSING UNIT should be placed near the OPTICAL UNIT location within the limits of 10m interconnection cables supplied. Rack-mounting is available as illustrated in Fig. 2-3. The rack-mounting kit is optional.

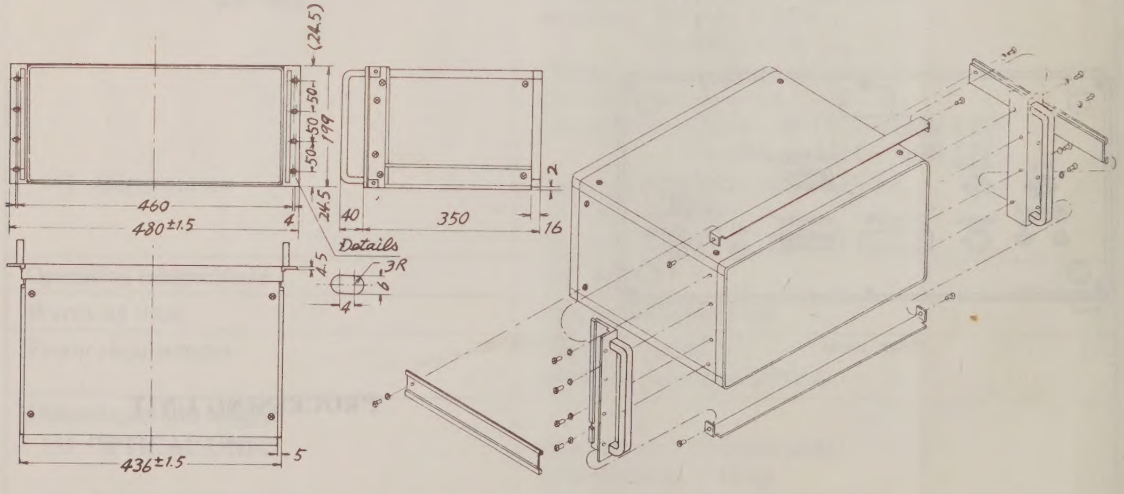


Fig. 2-3 Rack Mounting

System setup for measurement is shown in Fig.2-4.

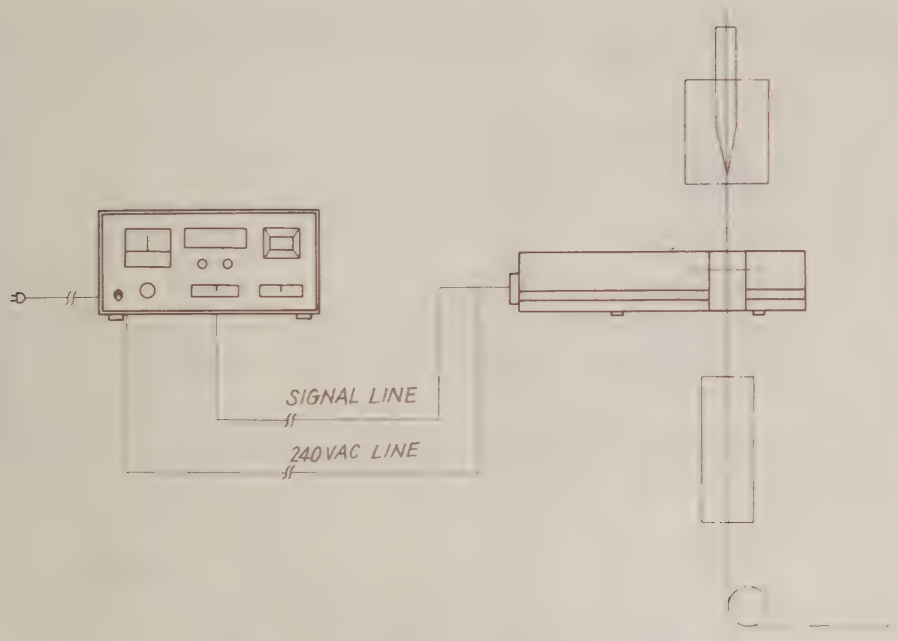


Fig. 2-4 System Setup for Measurement

2.2 AC Line Connection

The input power cords for the OPTICAL and the PROCESSING UNIT permit connection to 240 VAC, 50 or 60 Hz line powers. The power cord for the OPTICAL UNIT should be connected to the plug on the rear panel of the PROCESSING UNIT.

2.3 Operating Temperature

The equipment can be operated where the ambient air temperature is between 0°C and +40°C. If the OPTICAL UNIT is located closely to a heat source as an oven, heat isolation is required. Moreover, to prolong the useful life of the laser system in the OPTICAL UNIT, it is desired to keep ambient temperature about 30°C or lower.

2.4 Operator Safety

The He-Ne laser used in the M501A is of 1 mW power, and even maximum energy density obtained by focusing the beam can not affect human skin and the clothes. The power of the scanning beam is less than 0.3 mW and is not emitted out when the object is not inserted in the measuring area. Although reflected beam is reduced in intensity, avoid long time exposure of human eyes to the beam.

2.5 Panel Features

A brief description of the function of the front and rear panel controls and connectors are as follows. See Fig. 2-5 to Fig. 2-8 dor locations.

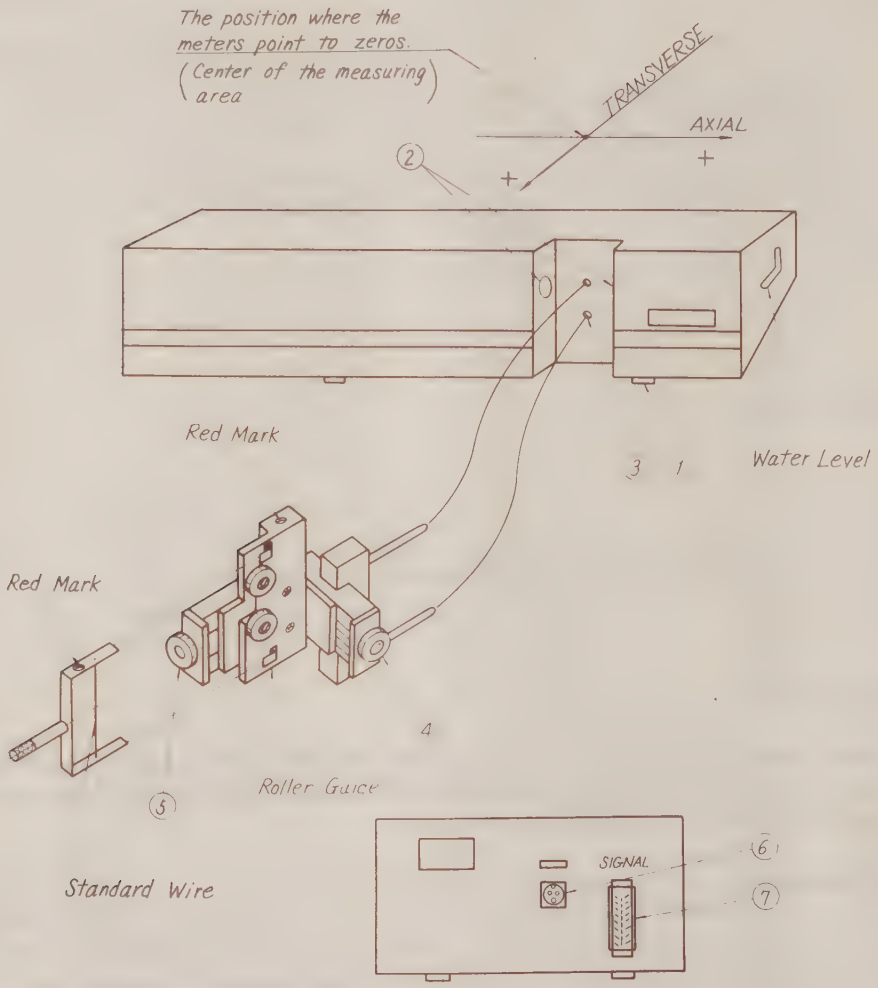


Fig. 2-5 OPTICAL UNIT Panel and Mounting of Roller Guide and Standard Wire

① Feet which support the OPTICAL UNIT, are isolated against the body. The thread holes (M10, P=1.5) at the center of the feet can be used to fix the UNIT.

② Filters to protect the optical components from the contaminations.
If the dust is attaching on the filter where the scanning laser beam should pass through, the stable measurements are not always maintained.

③ Mount base for the grooved roller guide.

④ Knob to move the roller guide along the laser beam direction.

⑤ Knob to move the roller guide in the direction of scanning.

⑥ AC 240V connector. This connector provides means to connect 240V AC line to PROCESSING UNIT through the AC 240V OUT connector.

⑦ SIGNAL connector. This connector provides means to connect signals to PROCESSING UNIT through the DETECTOR connector.

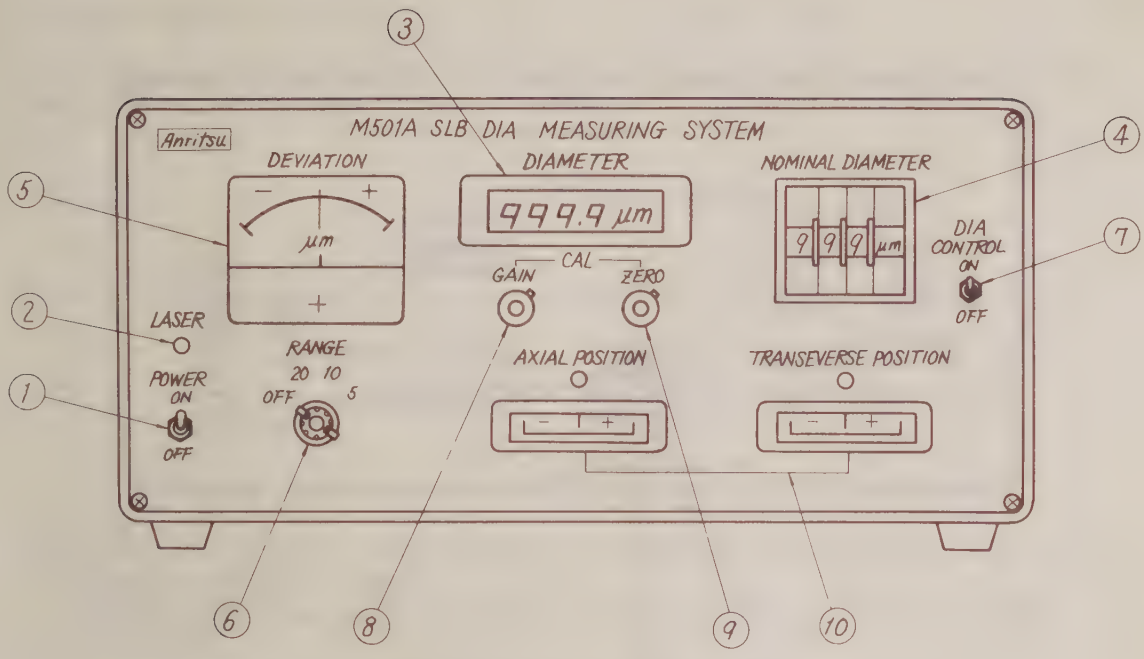


Fig. 2-6 PROCESSING UNIT Front Panel

① POWER switch. This is the power switch of the system.

② LASER monitor lamp. The LED lamp should light when the intensity of the laser light is enough to the measurement. When the orange-colored light turns to green through the measurement is being secured, a spare laser should be prepared. In this condition the laser have the power between 40 to 50% of the initial level.

③ DIAMETER window. The diameter of the object is displayed digitally at the window.

④ NOMINAL DIAMETER digital switch. This switch allows to preset the nominal diameter of object to be produced.

⑤ DEVIATION meter. This meter indicates the difference between the measured and nominal diameter.

⑥ RANGE switch. This switch selects the full scale of the DEVIATION meter.

⑦ DIA CONTROL switch. This switch allows to turn off the analog output from the CONTROL connector Pin No. 2 for the outer diameter controller.

⑧ GAIN potentiometer. This potentiometer allows to change the gain of the output value.

⑨ ZERO potentiometer. This potentiometer allows to eliminate the offset of the output value. The GAIN and ZERO potentiometers are used for the instrument calibration.

⑩ AXIAL POSITION meter indicates the position along the laser beam. TRANSVERSE POSITION meter indicates the position in the direction of laser beam scanning. When the object being measured lies at the center of the measuring area, both meters point to zeros. The sign of the position shows Fig. 2-5.

The LED lamps over the meters should light when the object to be measured lies in the measuring area.

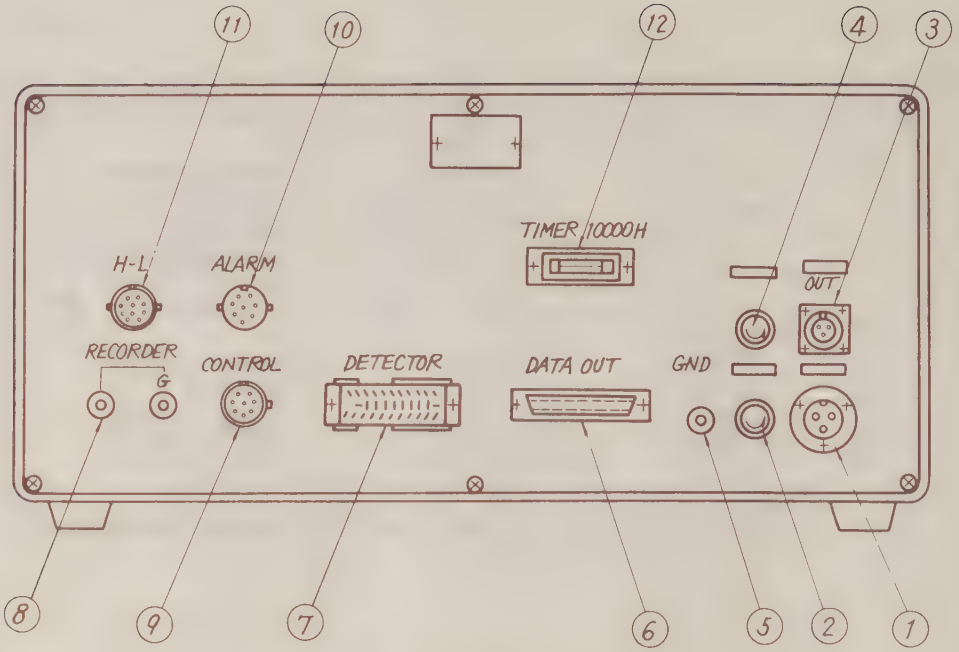
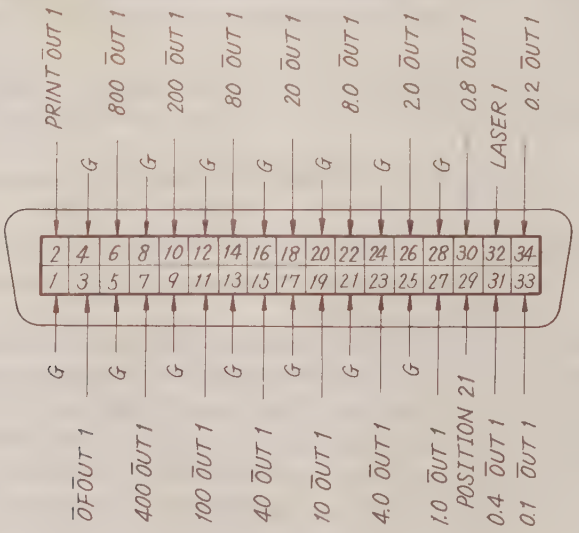


Fig. 2-7 PROCESSING UNIT Rear Panel

① AC 240V power input connector.
② 1A fuse for the PROCESSING UNIT.
③ AC 240V OUT connector.
④ 0.5A fuse for the laser power supply in the OPTICAL UNIT.
⑤ GND terminal. This is the common ground terminal of the units. .
⑥ DATA OUT connector. This connector provides the digital outputs of the diameter as shown in Fig. 2-8. The level of outputs are that of TTL open-collector. (MAX 5.5V, 16mA)



G : Ground
PRINT OUT 1 : Output terminal for the print comand
POSITION 21 : In the measuring area; low level
LASER 1 : If nomal; high level

Fig. 2-8 DATA OUT Connector

Note: How to use PRINTOUT

If the terminal 2 is in high level (+5V) or open, the analogue-to-digital converter acts successively with a period of 100 msec. See Fig. 2-9.

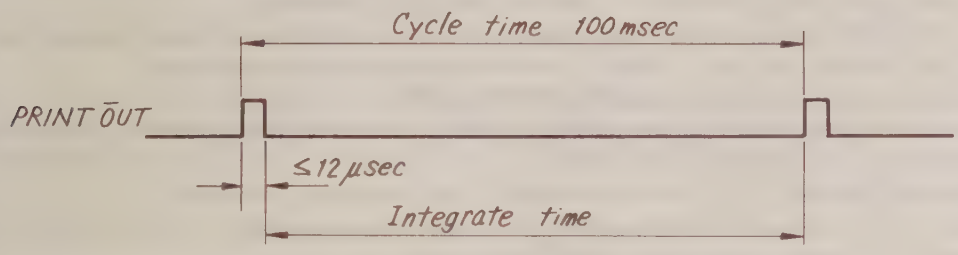


Fig. 2-9 Timing Diagram

⑦ DETECTOR connector. This connector provides means to connect signals to the OPTICAL UNIT through the SIGNAL connector

⑧ RECORDER terminal. This terminal provides the deviational output of the diameter, 10 mV/μm, to a recorder.

⑨ CONTROL connector. This 8P connector provides following four analog outputs:

Pin No.	Description
1	Deviation of the diameter, 10 mV/μm, MAX ±10~15V. Note) This signal is identical to the signal of the RECORDER terminal.
2	Deviation of the diameter for the controller, 500 mV/μm, ±5V limiter.
3	Position of the object in the direction of scanning, 5 V/mm.
4	Position of the object along the laser beam, 5 V/mm.
5, 6	Ground

The signs of the position output and indication of the position meter are inverted.

⑩ ALARM connector. This connector provides alarm signals which synchronize to the LED lamps as follows:

Pin No.	Description
1 2	LASER, If power down; 1-2 short-circuited
4 5	POSITION Out of the measuring area; 4-5 short circuited

⑪ H-L connector. This connector provides means to connect signals to the M436C HIGH-LOW UNIT.

⑫ TIMER. This timer indicates accumulated operating time of this system. Its full scale is 10000H.

2.6 Operation

2.6.1 Preliminary Instructions

(1) Install the OPTICAL UNIT at an proper position on the production line. The OPTICAL UNIT is isolated against the earth when it is fixed by the thread holes below.
(2) Check to make certain that the fuses of the PROCESSING UNIT are properly installed, and that the line voltage to be used is same to the value indicated on the nameplate.
(3) Turn off the power switch of the PROCESSING UNIT.
(4) Connect the 10m power cord and SIGNAL cable to the OPTICAL UNIT and to the rear panel receptacles of the PROCESSING UNIT.
(5) The PROCESSING UNIT should be grounded with high quality conductor.
(6) Connect the 2.5m power cord to a 240V AC, 50/60 Hz power source.
(7) Turn on the power switch of the PROCESSING UNIT.
(8) Check to ensure that the lamp LASER on the front panel of the PROCESSING UNIT light.
(9) Insert the two pins of the roller guide to the holes on the mount base on the OPTICAL UNIT, and install the standard wire along side the roller guide in a manner illustrated in Fig. 2-5. Uncalibrated wire diameter is indicated digitally and the wire position is indicated on the two position meters.
(10) The position of the wire installed in the roller guide can be adjusted by the knob (⑤ in Fig 2-5) transversely, and by the knob (④ in Fig. 2-5) of the roller guide axially.
(11) Set the digital switches of the NOMINAL DIA to an approximate value of that wire diameter. Then the difference between the digital value displayed and the NOMINAL DIA is appears on the analog DEVIATION meter. At the same time, analog voltage of the deviation is output from the RECORDER terminals and CONTROL terminals.
(12) Allow a laser preheat time of 30 minutes maximum for the stabilization of the instrument.

2.6.2 Calibration Procedure

(1) Prepare two standard wires A and B with the outside diameters D_1 D_2 respectively, and thoroughly clean them.
(2) Install each wire on the roller guide and adjust the wire position in a manner mentioned in 2.6.1. The values D_1' (A) and D_2' (B) will be displayed.
(3) If the wire A (or B) is still installed, turn the ZERO on the front panel of the PROCESSING UNIT, until

$$d_1 = \frac{(D_1'-D_2')D_1}{D_1-D_2} \qquad \text{or } d_2 = \frac{(D_1'-D_2')D_2}{D_1-D_2}$$

is displayed. Then turn the GAIN until value D_1 (or D_2) is displayed. If the wire B (or A) is installed again, the value displayed will be D_2 (or D_1). Calibration is now completed.
Then, if the object is not in the measuring area, the digital indication is not necessary to become zero.
(4) An approximate calibration procedure is as follows. Install a standard wire whose diameter is close to that of the object under question, and adjust "ZERO" until the true wire diameter is displayed.

2.6.3 Measurement

(1) Adjust the position of the OPTICAL UNIT so that the object passes through the mid-position of the measuring area using the two POSITION SET meters. Check to ensure that the lamps POSITION light.
(2) Direction of the scanning must be perpendicular to the axis of the object fiber or wire. When the object runs parallel to a vertical line or horizontal line, the direction of scanning can be decided by referencing the water level on the side face of the OPTICAL UNIT. Tilt of the direction of the scanning results an increase in diameter measured as follows:

angle of tilt	increase in diameter
1°	0.02%
2°	0.06%
3°	0.14%
5°	0.38%

(3) Let the object travel, then the outside diameter will be displayed. The deviation from the value of the NOMINAL DIA is indicated by the DEVIATION meter and is emitted from both the terminal RECORDER and CONTROL on the rear panel.

2.6.4 Accuracy Check

Test the followings whether the accuracy of the equipment is maintained or not.

(1) Calibration: Every day or every week, perform the calibration procedure mentioned in the section 2.6.2.

(2) Repeatability: Every few months, measure the variation by moving the standard wire within the measuring area.

SECTION 3

PRINCIPLE OF OPERATION

3.1 Introduction

The equipment is useful to measure the outside diameter of glass and plastic fiber, steel wire and other opaque or transparent object by using a laser scanner which consists of an oscillating mirror and a lens assembly. The oscillating mirror contacts to the top of the tuning fork.

Since the frequency of the scanner is 500 Hz high and the direction of the laser beam movement changes alternatively in sign, the measurement of the moving object become accurate. Long-term stability is maintained by stabilizing the scanner amplitude and eliminating the effect of laser power variation. The equipment, therefore, useful in the on-line measurement, and is available with both digital read-out and analogue control.

3.2 OPTICAL UNIT

Fig. 3-1 to Fig. 3-3 show the arrangement of the optical system, the block diagram of the circuit and the wave forms of main signals. The laser beam B from the He-Ne gas laser is expanded and is reflected by the oscillating mirror M_2 installed on the top of the tuning fork. Then it passes through a half mirror HM_1 to produce the beam B_D which scans the object under measurement and the monitor beam B_M. The monitor beam B_M is again split into two beams through a half mirror HM_2. One beam scans the knife edge to obtain the phase signal S_1 of the oscillating mirror. The other beam scans the monitor wire to obtain the signal S_2 which is used to stabilize the oscillating amplitude.

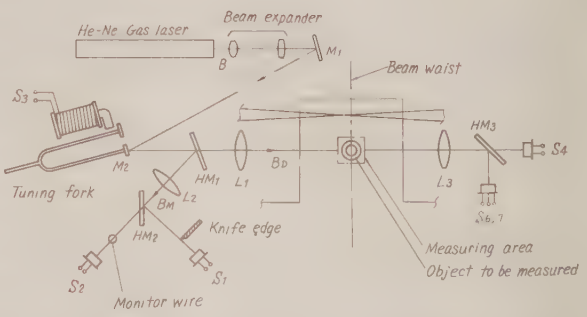


Fig. 3-1 Arrengement of the Optical System

The light which is not scattered by the object is split and is incident to photo-detectors, which produce the photo-current S_4, S_6 and S_7. The pulse width of the signal S_4 contains the information of the diameter.

The signal S_6 and S_7 is similar to the signal S_4, but their phases are different slightly each other. The phase difference results from the optical arrangement that detects the variation of a light density over the cross section of the scanning beam. The variation occurs just when the B_D moves across the object edge. The phase difference, thus caused, is proportional to the distance between the object and the waist of the beam B_D.

The tuning Fork assembly, the Phase Discriminator and the Controller forms an oscillator whose frequency is 500 Hz. The Phase Dis-

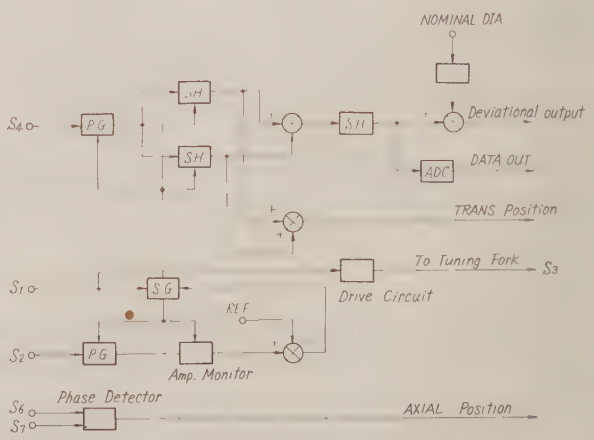


Fig. 3-2 Block Diagram of the Circuit

criminator compaires the phase of the coil current S_3 with that of the phase signal S_1. Then the Controller adjusts the phase of the S_3 using the output of the Phase Discriminator. The Controller also regulates the amplitude of the S_3, so that the diameter of the Monitor wire seems accurately constant. The diameter of the Monitor wire is measured by the same method which will be described in section 3.3.3. The mirror M_2, therefore, oscillates sinusoidally with a stable amplitude.

The signals S_1, S_2, S_4, S_6 and S_7 are amplified and applied into the PROCESSING UNIT.

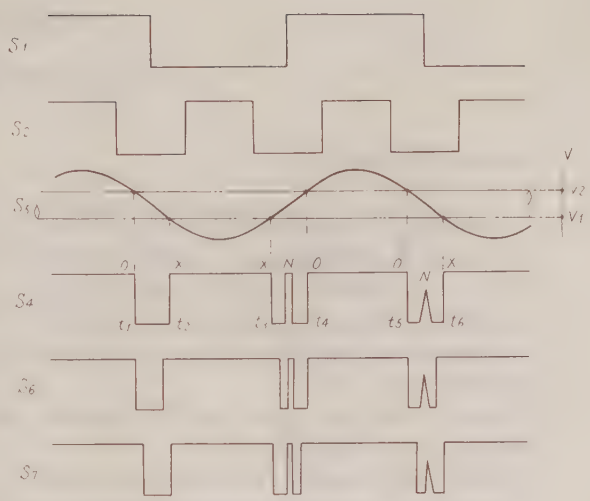


Fig. 3-3 Wave Forms of Main Signals

3.3 PROCESSING UNIT

The PROCESSING UNIT consists of three major blocks, that is, the Signal Generator for simulating the scanning beam, the Output Circuit for determining the diameter and ADC.

3.3.1 Signal Generator

To simulate the M_2 mirror motion or the scanning beam movement, the sinusoidal signal S_5 whose phase is coinside with the signal S_1 is generated using the phase lock method. The electric voltage of the S_5, therefore, is proportional to the laser beam position at the measurement area. In addition, various control pulses synchronizing to the S_5 is produced.

3.3.2 Output Circuit

From the signal S_4, an instant when the laser beam just passes the edge of the object is obtained by using the limiter circuit in which the laser power variation is compensated. The position of the object edge which corresponds to one end of the diameter is determined by sampling the voltage of the signal S_5 at that instant. The diameter of the object, therefore, is proportional to the difference between the outputs of two sample hold amplifiers corresponding to the two end of the diameter.

If the object under question is an transparent fiber, additional edge-like pulses appear between the two correct edge pulses. But the additional pulses can be eliminated using the logic circuit and an additional sample hold amplifier.

In this block the deviation and the position of the object are also obtained. The deviation of the diameter from the NOMINAL are obtained by subtracting the devided reference voltage from the voltage representing the diameter. The position of the object along the direction of scanning is found by averaging the voltages corresponding to the two edge positions.

3.3.3 ADC

Using the V-F Converter and the Frequency Counter, the analog signal proportional to the diameter is converted to the digital signal and then digitally displayed.

SECTION 4

MAINTENANCE

4.1 General Maintenance

(1) Two MONITOR lamps, POSITION, must light during measurement. If either lamp flickers or goes out, exact measurement can not be performed. Check and readjust the object position.
(2) When the vibrational amplitude of the object is so high as to be out of the measuring area, spike-like noises, which always indicate smaller value, appears in the output.
(3) Keep clean the glass filters which are installed at the entrance and exit of the scanning laser beam in the OPTICAL UNIT.
(4) Usually, don't move positions of the mirrors and lenses in the OPTICAL UNIT. All these have been adjusted and locked.
(5) Do not apply impact to the OPTICAL UNIT.

The replacement of the laser system is shown schematically in Fig. 4-1. The new laser tube mounted by Anritsu should again be installed by attaching the mount to two pins fixed and binding it by three screws. Other adjustment is not necessary for the optical system. Mounted spare lasers whose beam position are accurately adjusted are always stored by Anritsu.

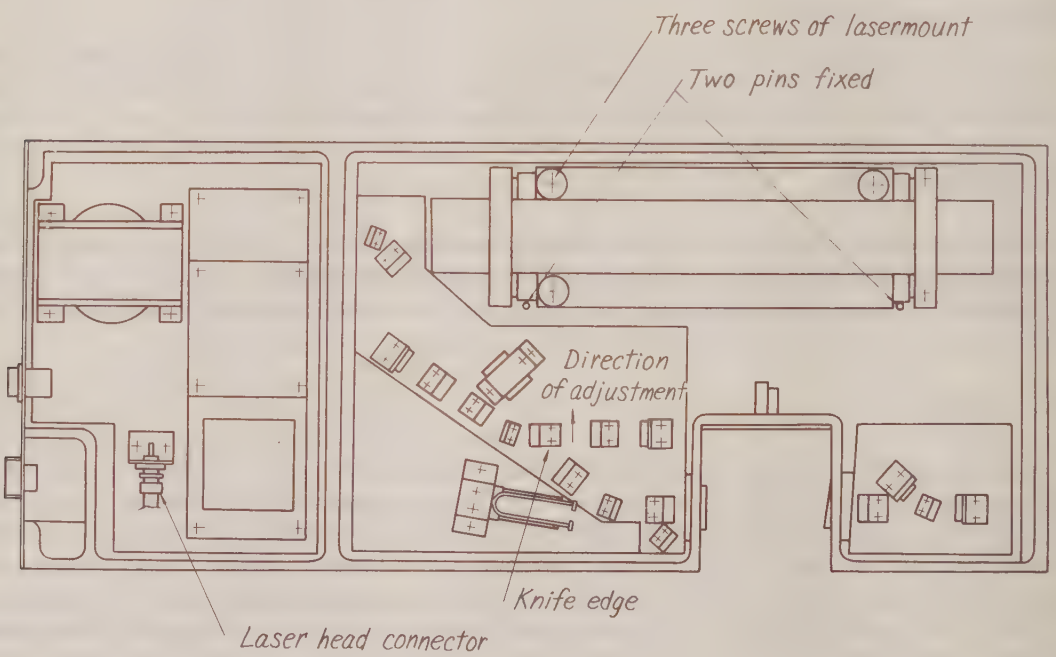


Fig. 4-1 Upper View of the OPTICAL UNIT removing the covers

4.2 Performance Test

The following checks are intended for successive use of M501A.

(1) OPTICAL UNIT U1

Table 4-1

Location	Signal wave form required	Location	Signal wave form required
J4-1 (J4-10:GND)	Duty: 50± 5%	J4-4 and J4-5	Amplitudes of both signals at J4-4 and J4-5 must be equal
J4-2	Duty: 50± 5%	J6	6± 2V DC
J4-3	Ripple: within 10% p-p		

(2) PROCESSING UNIT

Table 4-2

Location	Level	Correction if necessary
U1-E2	7± 1V	U1-R26
U1-E13	8± 0.01V	U1-R87

NOMINAL DIA

Equipment required is a digital voltmeter having an accuracy within 0.005%.

Table 4-3

NOMINAL	Voltage at E13	Adjustment
100μm	−1000± 1 mV	R88
200	−2000± 1	R139
400	−4000± 1	R138
800	−8000± 1	R137

DC power source Z_2 in PROCESSING UNIT

Table 4-4

CKT REF	Voltage	Ripple	Stability	Terminal in OPTICAL UNIT
J1-12	+5± 0.1V	50 mV_{p-p}	0.5%	J2-18
J1-8	+15± 0.1V	50	0.5	J2-3
J1-9	+15± 0.1V	50	0.5	J2-5

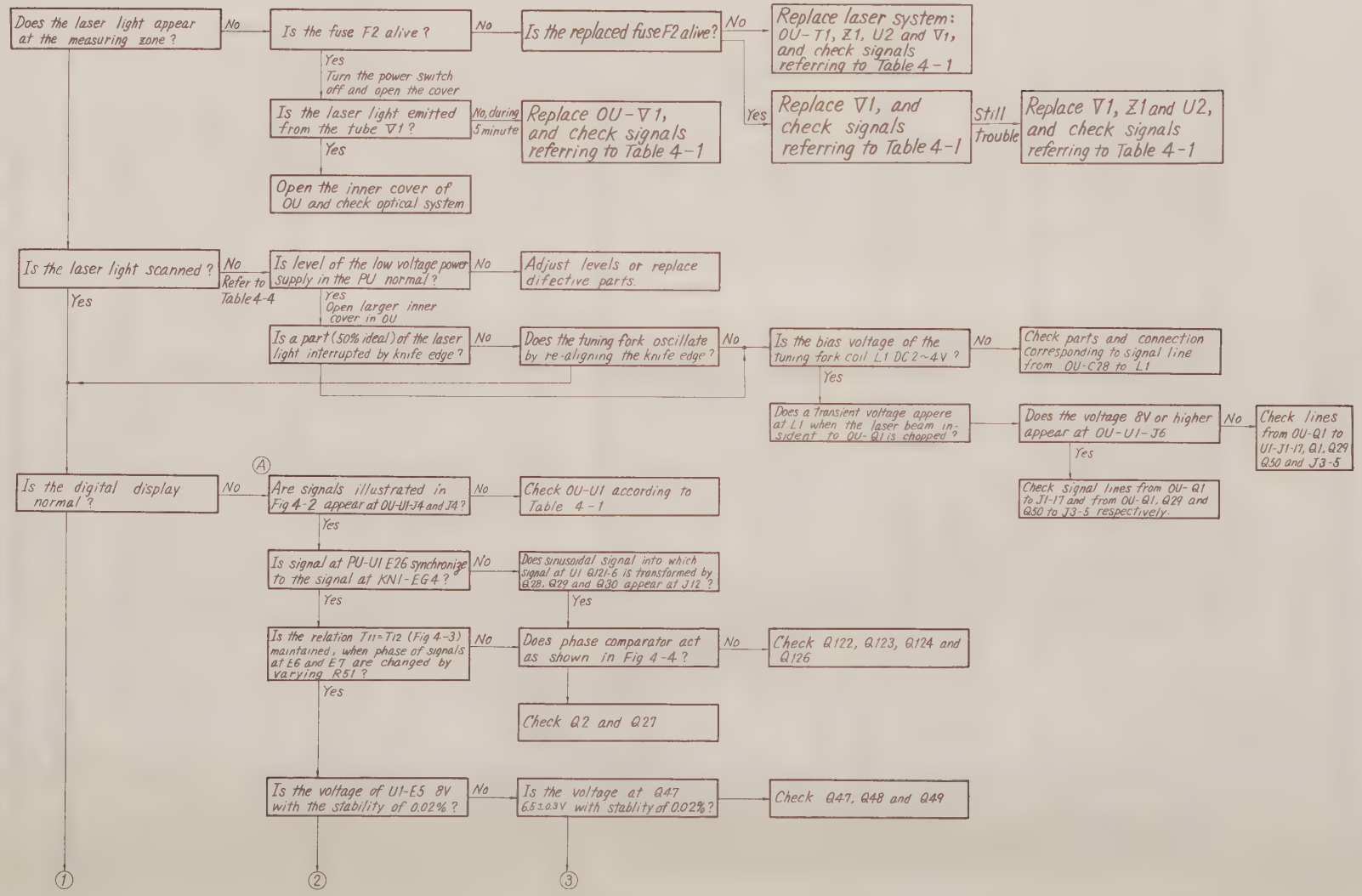
4.3 Troubleshooting

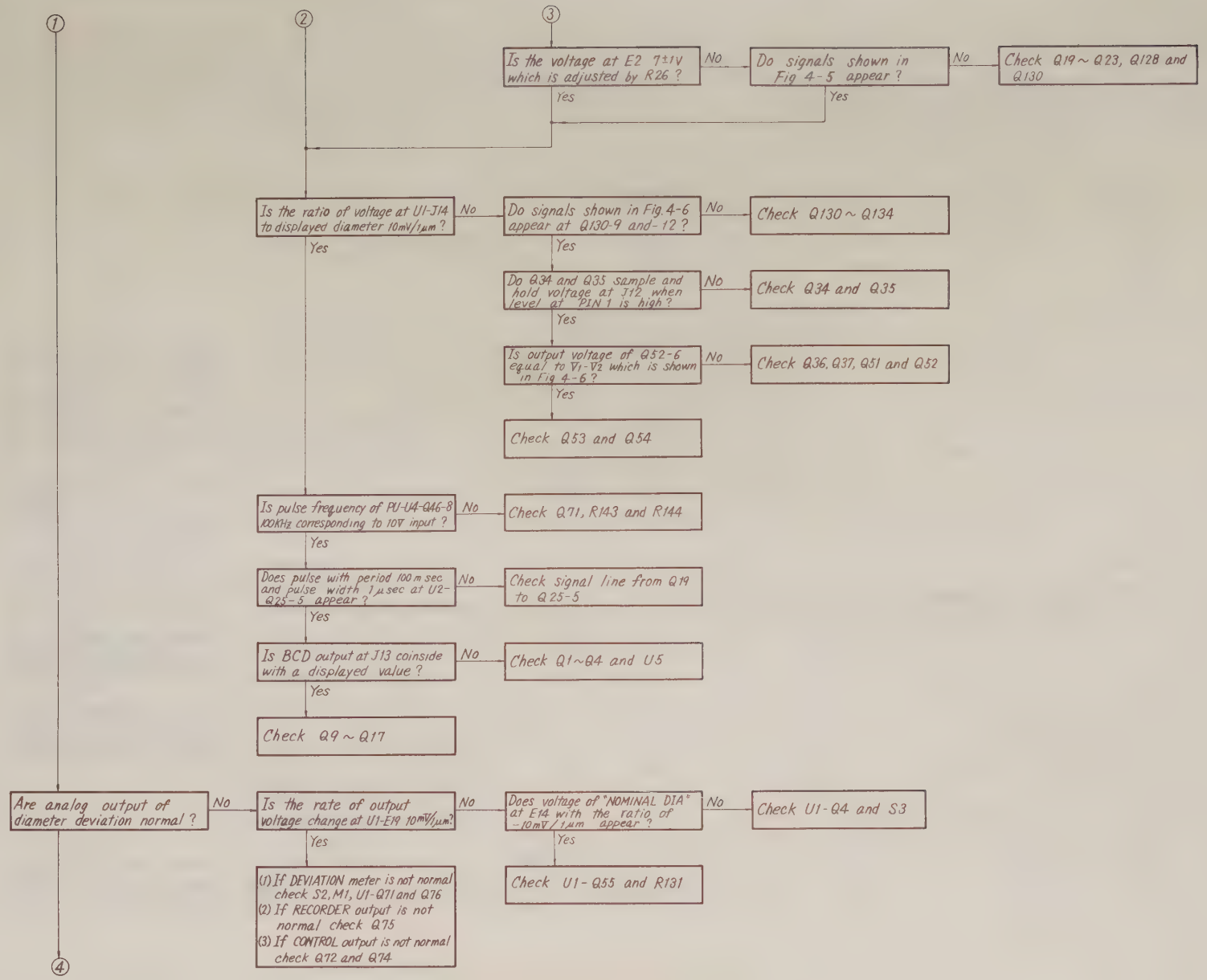
The following chart is provided to facilitate troubleshooting of the M501A.

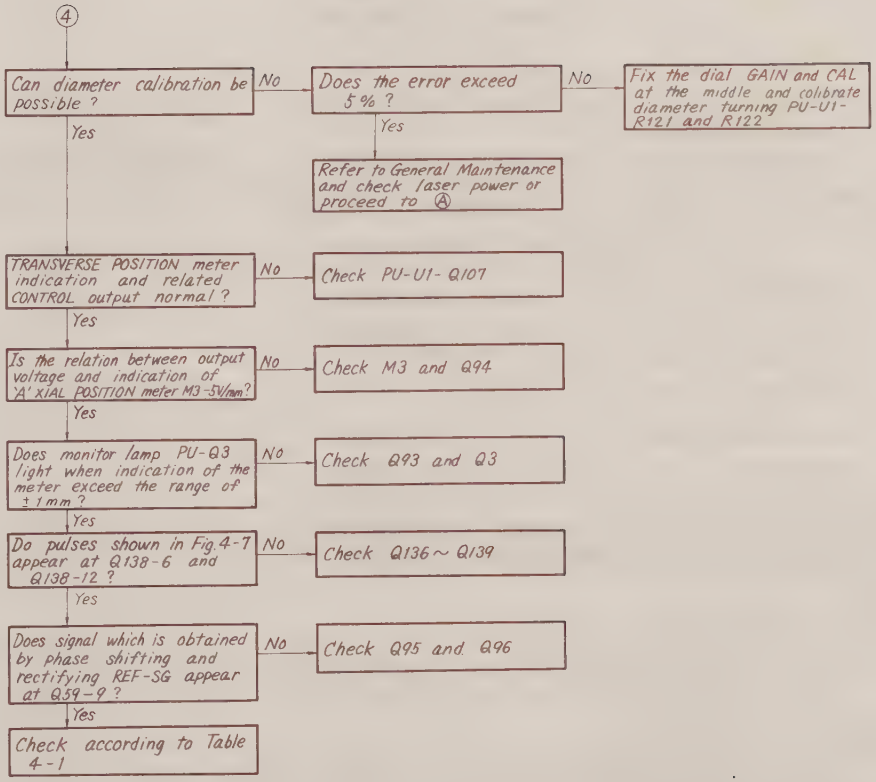
The Table 4-1~4-5 should be used in locating the defective component. An understanding of the principle of operation is also very helpful in locating troubles.

Troubleshooting Chart for M501A

Abbreviations: OPTICAL UNIT ····· OU
PROCESSING UNIT ····· PU


Does the laser light appear at the measuring zone ?
No
Is the fuse F2 alive ?
No
Is the replaced fuse F2 alive?
No
Replace laser system: OU-T1, Z1, U2 and ∇1, and check signals referring to Table 4-1
Yes
Turn the power switch off and open the cover
Is the laser light emitted from the tube ∇1 ?
No, during 5 minute
Replace OU-∇1, and check signals referring to Table 4-1
Yes
Replace ∇1, and check signals referring to Table 4-1
Still Trouble
Replace ∇1, Z1 and U2, and check signals referring to Table 4-1
Yes
Open the inner cover of OU and check optical system
Is the laser light scanned ?
No
Refer to Table 4-4
Is level of the low voltage power supply in the PU normal ?
No
Adjust levels or replace difective parts.
Yes
Open larger inner cover in OU
Yes
Is a part (50% ideal) of the laser light interrupted by knife edge ?
No
Does the tuning fork oscillate by re-aligning the knife edge ?
No
Is the bias voltage of the tuning fork coil L1 DC 2~4V ?
No
Check parts and connection corresponding to signal line from OU-C28 to L1
Yes
Does a transient voltage appere at L1 when the laser beam incident to OU-Q1 is chopped ?
Does the voltage 8V or higher appear at OU-U1-J6
No
Check lines from OU-Q1 to U1-J1-17, Q1, Q29 Q30 and J3-5
Yes
Check signal lines from OU-Q1 to J1-17 and from OU-Q1, Q29 and Q30 to J3-5 respectively.
Ⓐ
Is the digital display normal ?
No
Are signals illustrated in Fig 4-2 appear at OU-U1-J4 and J4 ?
No
Check OU-U1 according to Table 4-1
Yes
Is signal at PU-U1 E26 synchronize to the signal at KN1-EG4 ?
No
Does sinusoidal signal into which signal at U1 Q121-6 is transformed by Q28, Q29 and Q30 appear at J12 ?
Yes
Yes
Is the relation T11=T12 (Fig 4-3) maintained, when phase of signals at E6 and E7 are changed by varying R51 ?
No
Does phase comparator act as shown in Fig 4-4 ?
No
Check Q122, Q123, Q124 and Q126
Yes
Check Q2 and Q27
Is the voltage of U1-E5 8V with the stability of 0.02% ?
No
Is the voltage at Q47 6.5±0.3V with stablity of 0.02% ?
Check Q47, Q48 and Q49
①
②
③


①
②
③
④
Is the voltage at E2 7±1V which is adjusted by R26 ?
No
Do signals shown in Fig 4-5 appear ?
No
Check Q19 ~ Q23, Q128 and Q130
Yes
Yes
Is the ratio of voltage at U1-J14 to displayed diameter 10mV/1μm ?
No
Do signals shown in Fig. 4-6 appear at Q130-9 and-12 ?
No
Check Q130 ~ Q134
Yes
Yes
Do Q34 and Q35 sample and hold voltage at J12 when level at PIN 1 is high ?
No
Check Q34 and Q35
Yes
Is output voltage of Q52-6 equal to V1-V2 which is shown in Fig 4-6 ?
No
Check Q36, Q37, Q51 and Q52
Yes
Check Q53 and Q54
Is pulse frequency of PU-U4-Q46-8 100KHz corresponding to 10V input ?
No
Check Q71, R143 and R144
Yes
Does pulse with period 100 m sec and pulse width 1 μsec at U2-Q25-5 appear ?
No
Check signal line from Q19 to Q25-5
Yes
Is BCD output at J13 coinside with a displayed value ?
No
Check Q1~Q4 and U5
Yes
Check Q9 ~ Q17
Are analog output of diameter deviation normal ?
No
Is the rate of output voltage change at U1-E19 10mV/1μm?
No
Does voltage of "NOMINAL DIA" at E14 with the ratio of -10mV / 1μm appear ?
No
Check U1-Q4 and S3
Yes
Yes
(1) If DEVIATION meter is not normal check S2, M1, U1-Q71 and Q76
(2) If RECORDER output is not normal check Q75
(3) If CONTROL output is not normal check Q72 and Q74
Check U1-Q55 and R131


④
Can diameter calibration be possible ?
No
Does the error exceed 5% ?
No
Fix the dial GAIN and CAL at the middle and colibrate diameter turning PU-U1-R121 and R122
Yes
Yes
Refer to General Maintenance and check laser power or proceed to Ⓐ
TRANSVERSE POSITION meter indication and related CONTROL output normal ?
No
Check PU-U1-Q107
Yes
Is the relation between output voltage and indication of 'A' XIAL POSITION meter M3-5V/mm?
No
Check M3 and Q94
Yes
Does monitor lamp PU-Q3 light when indication of the meter exceed the range of ±1mm ?
No
Check Q93 and Q3
Yes
Do pulses shown in Fig.4-7 appear at Q138-6 and Q138-12 ?
No
Check Q136 ~ Q139
Yes
Does signal which is obtained by phase shifting and rectifying REF-SG appear at Q59-9 ?
No
Check Q95 and Q96
Yes
Check according to Table 4-1

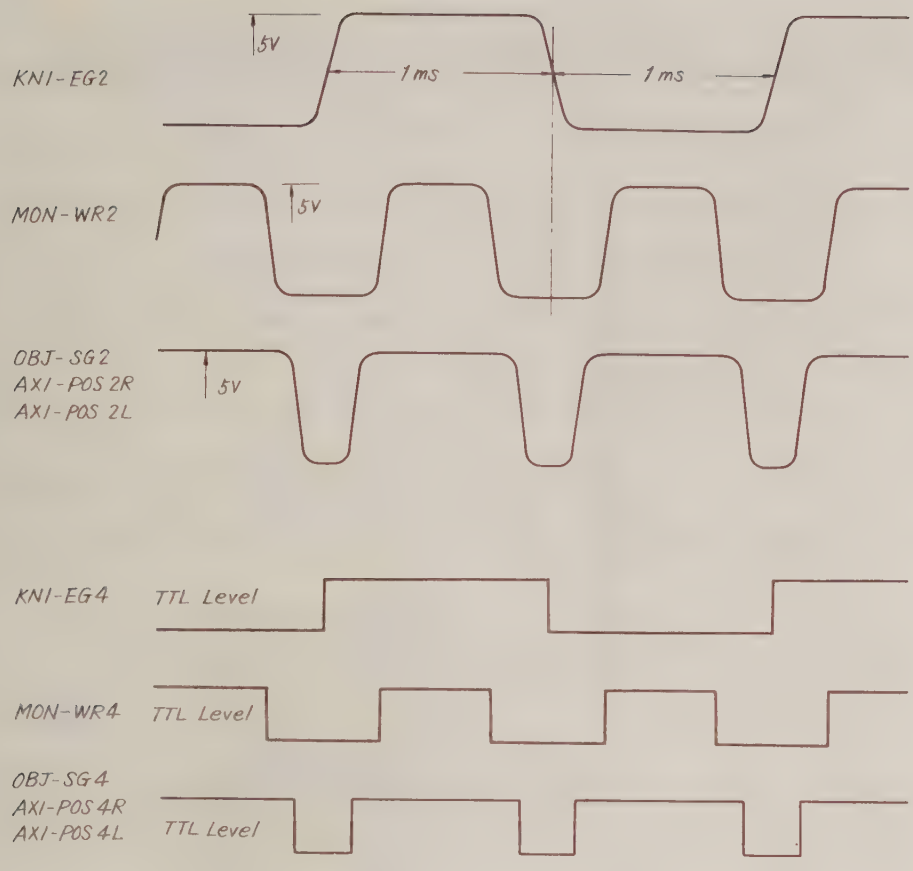


Fig. 4-2 Signals of OPTICAL UNIT

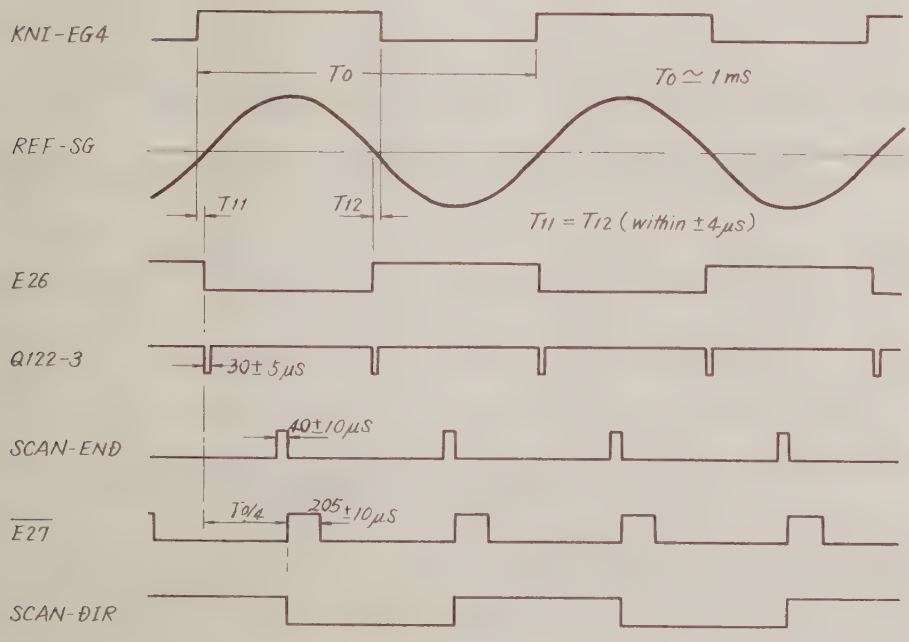


Fig. 4-3 Control Signals to be processed

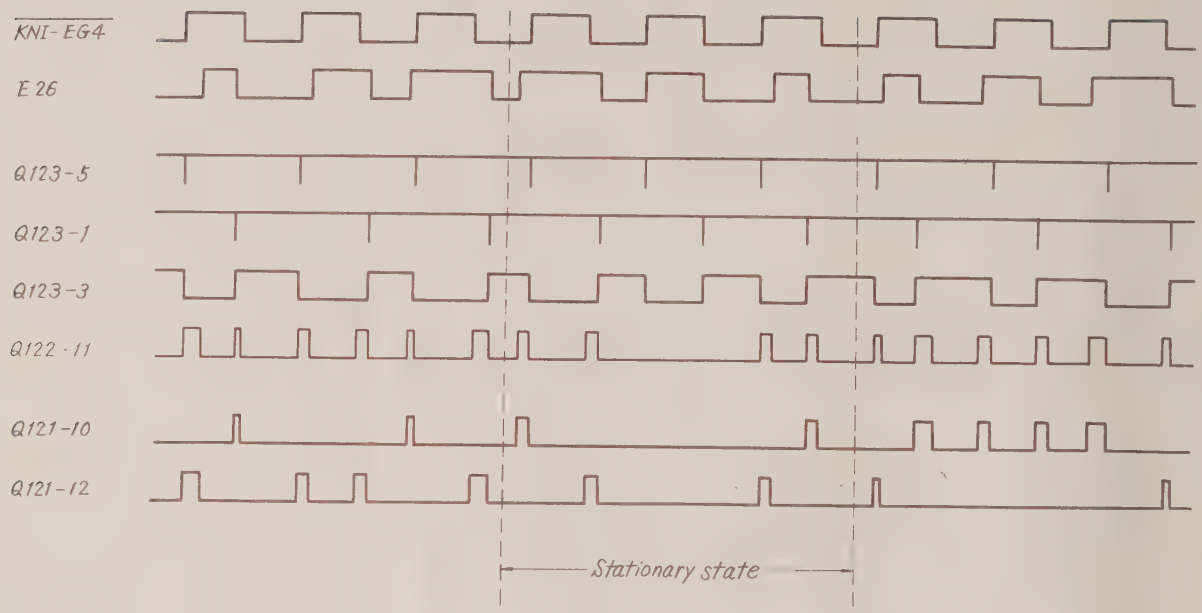


Fig. 4-4 Phase Comparator

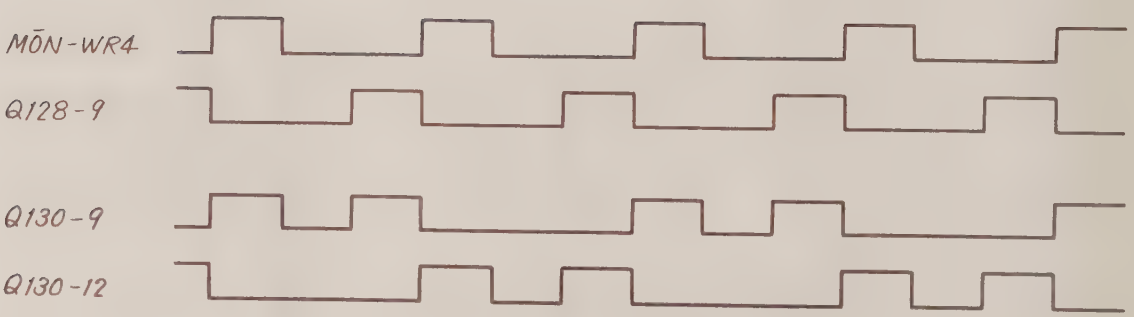


Fig. 4-5 Processing of the signal MON-WR4

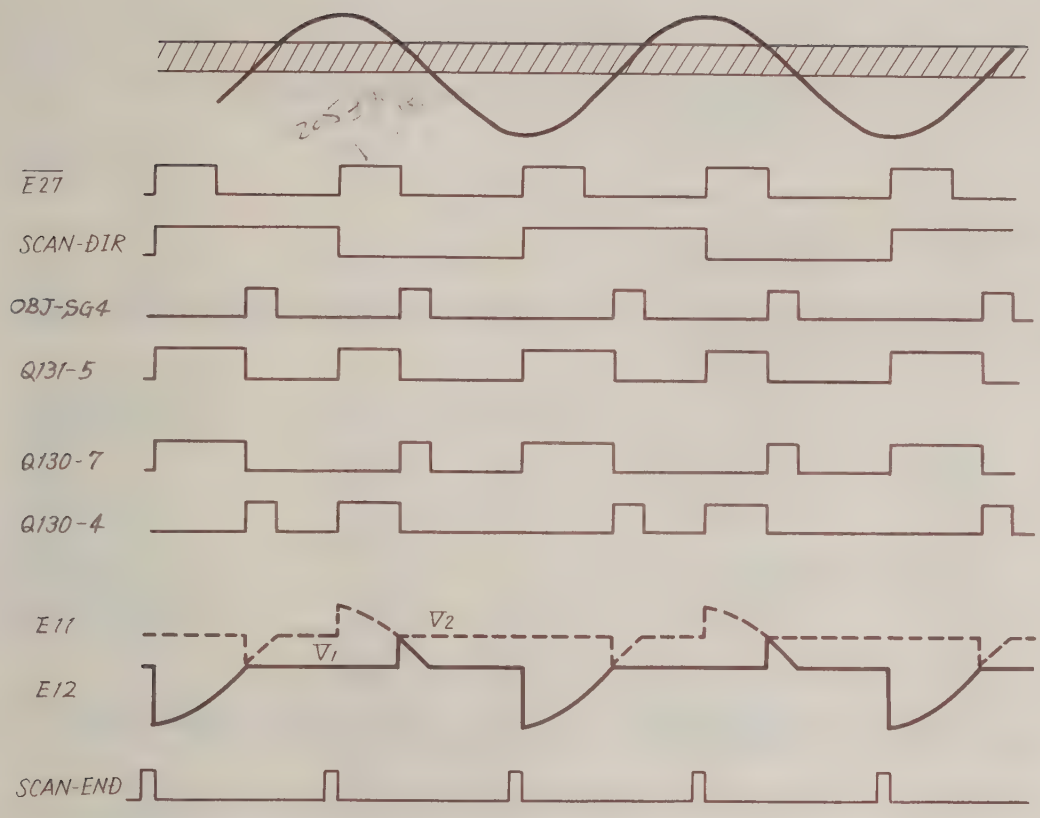


Fig. 4-6

Signal Timing to yield an analog signal proportional to the outside diameter

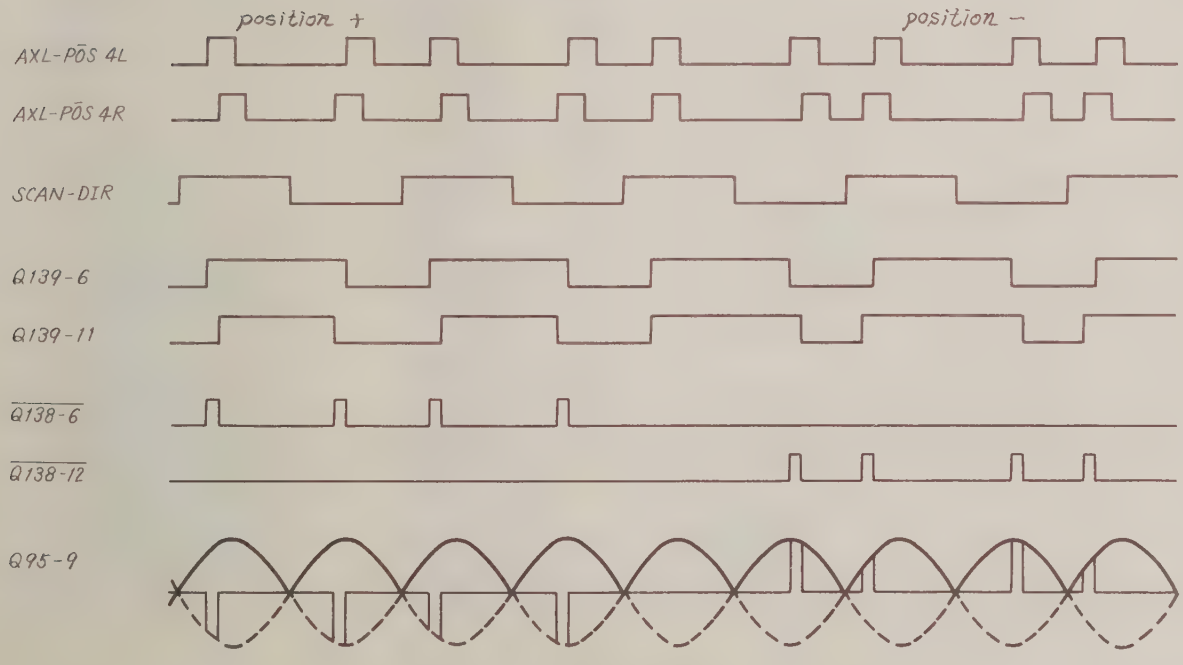


Fig. 4-7 AXIAL Position

SECTION 5

COMPONENT LISTS AND SCHEMATIC DIAGRAMS

Circuit References and Abbreviations:

The following table shows circuit references (hereinafter CKT REF) and abbreviations used for components given in the component list.

CKT REFE

C:	Capacitor	R:	Resistor
E:	Terminal	S:	Switch
F:	Fuse	T:	Transformer
J:	Jack, plug, connector	U:	Unit
K:	Relay	V:	Neon lamp
L:	Coil	X:	Crystal
M:	Meter, timer	Z:	Power Supply, Filter, Rectifier
Q:	Transistor, Diode, Rectifier, IC		

Abbreviations

A:	amperes	NPN:	negative-positive-negative
Cap:	capacitor	Ω:	ohm
Cer:	ceramic	p:	pico ($\times 10^{-12}$)
CF:	carbon film	Plast:	plastic film
CT:	cermet trimmer	PNP:	positive-negative-positive
Di:	diode	Res:	resistor
Elect:	electrolyte aluminum	Si:	silicon
F:	farad	Sw:	switch
H:	henry	Tant:	tantalum
Hz:	hertz	TF:	thin film
IC:	integrated circuit	Tr:	transistor
k:	kilo ($\times 10^{3}$)	Trans:	transformer
LED:	light emitting diode	μ:	micro ($\times 10^{-6}$)
M:	mega ($\times 10^{6}$)	V:	volt
m:	milli ($\times 10^{-3}$)	Var:	variable
MF:	metallized film	W:	watt
MG:	metallized glaze	WW:	wire wound

TABLE 5-1 M501A D1A MEASURING SYSTEM

CKT REF	DESCRIPTION	RATING
A 1	OPTICAL UNIT	
A 2	PROCESSING UNIT	

TABLE 5-2 A1 OPTICAL UNIT

CKT REF	DESCRIPTION	RATING
J 1	Inter Connector, (U-SB2203)	
J 2	Inter Connector, (U-SB2203)	
J 3	Inter Connector, (U-SA0503)	
J 4	Receptacle, (S-1334B-ST)	
J 5	Plug, (PRC03-21A10-3AM)	
J 6	Connector, (JUG 931/U)	
L 1	Coil, (542L5240)	
Q 1	Photo-Detector, (PIN-5D)	
Q 2	Photo Detector, (PIN-5D)	
Q 3	Photo Detector, (PIN-5D)	
Q 4	Photo Detector, (PINSPOT/2D)	
T 1	Trans, (GLS2025)	
U 1	Sensing Circut, (59W84)	
U 2	Current Controler (GLS2027)	
V 1	Laser Tube, (GLG5313)	
Z 1	Rectifier, (HVB-GL-10)	

TABLE 5-3 U1 SENSING CIRCUIT

CKT REF	DESCRIPTION	RATING
C 1		
C 2		
C 3		
C 4		
C 5		
C 6		
C 7		
C 8		
C 9		
C 10		
C 11	Cap, Plast, (ECQ-M05102KZ)	1000PF, ±10%, 50V
C 12	Cap, Tant, (CS02H1VR22M)	0.22μF, ±20%, 35V
C 13	Cap, Plast, (ECQ-M05102KZ)	1000PF, ±10%, 50V
C 14	Cap, Tant, (CS02H1VR22M)	0.22μF, ±20%, 35V
C 15	Cap, Plast(HCQ-M05102KZ)	1000PF, ±10%, 50V
C 16	Cap, Tant, (CS02H1VR22M)	0.22μF, ±20%, 35V
C 17	Cap, Plast, (ECQ-M05102KZ)	1000PF, ±10%, 50V
C 18	Cap, Tant, (CS02H1VR22M)	0.22μF, ±20%, 35V
C 19	Cap, Tant, (CS02H1C220M)	22μF, ±20%, 16V
C 20	Cap, Tant, (CS02HOJ6R8M)	68μF, ±20%, 6.3V
C 21	Cap, Tant, (CS02HOJ6R8M)	6.8μF, ±20%, 6.3V
C 22	Cap, Tant, (CS02HOJ6R8M)	6.8μF, ±20%, 6.3V
C 23	Cap, Tant, (CS02HOJ6R8M)	6.8μF, ±20%, 6.3V
C 24	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 2.5V
C 25	Cap, Tant, (CS02H1C220M)	22μF, ±20%, 16V
C 26	Cap, Plast, (SFA-6340-2.5-25)	6340PF, ±2.5%, 25V
C 27	Cap, Plast, (SFA-6340-2.5-25)	6340PF, ±2.5%, 25V
C 28	Cap, Tant, (CS02H1C220M)	22μF, ±20%, 16V
C 29	Cap, Plast, (ECQ-M05473KZ)	0.047μF, ±10%, 50V
C 30	Not Assigned	
C 31	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 32	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 33	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 34	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 35	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 36	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 37	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 38	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 39	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 40	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 41	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 42	Cap, Elect, (CE04W1E470)	47μF +100/−10%, 25V
C 43	Cap, Elect, (CE04W1E470)	47μF +100/−10%, 25V
C 44	Cap, Elect, (CE04W1E470)	47μF +100/−10%, 25V
C 45	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%7, 25V
C 46	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 47	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 48	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 49	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 50	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 51	Cap, Elect, (CE04W1E470)	47μF, +100/−10%, 25V
C 52	Cap, Elect, (CE04W1E470)	47μF, +100/−10%, 25V
C 53	Cap, Elect, (CE04W1E470)	47μF, +100/−10%, 25V
C 54	Cap, Elect, (CE04W1E470)	47μF, +100/−10%, 25V
C 55	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 56	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 57	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 58	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 59	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 60	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 61	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 62	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 63	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 64	Cap, Elect, (CE04W1E470)	47μF, +100/−10%, 25V
E 1	Terminal, (P), (34J55599)	
E 2	Terminal, (P), (34J55599)	
E 3	Terminal, (P), (34J55599)	
E 4	Terminal, (P), (34J55599)	
E 5	Terminal, (P), (34J55599)	
E 6	Terminal, (P), (34J55599)	
E 7	Terminal, (P), (34J55599)	
J 1	Inter Connector, (U-PB2221)	
J 2	Inter Connector, (U-PB2221)	
J 3	Inter Connector, (U-PA0521)	
J 4	Inter Connector, (U-PA1021)	
J 5	Terminal, (J) (34J55600)	
J 6	Terminal, (P), (34J55599)	
J 7	Terminal, (P), (34J55599)	
Q 1	IC, (LF357BN)	
Q 2	IC, (LF357BN)	
Q 3	IC, (LF357BN)	
Q 4	IC, (LF357BN)	
Q 5	IC, (LF357BN)	
Q 6	IC, (μPC251A)	
Q 7	Di, Si, (1S953)	
Q 8	Di, Si, (1S953)	
Q 9	Di, Si, (1S953)	
Q 10	Di, Si, (1S953)	

CKT REF	DESCRIPTION	RATING
Q 11	IC, (μPC251A)	
Q 11	IC, (μPC251A)	
Q 12	Di, Si, (1S953)	
Q 13	Di, Si, (1S953)	
Q 14	Di, Si, (1S953)	
Q 15	Di, Si, (1S953)	
Q 16	IC, (μPC251A)	
Q 17	Di, Si, (1S953)	
Q 18	Di, Si, (1S953)	
Q 19	Di, Si, (1S953)	
Q 20	Di, Si, (1S953)	
Q 21	IC, (μPC251A)	
Q 22	Di, Si, (1S953)	
Q 23	Di, Si, (1S953)	
Q 24	Di, Si, (1S953)	
Q 25	Di, Si, (1S953)	
Q 26	Di, Si, (1S953)	
Q 27	Di, Si, (1S953)	
Q 28	Di, Si, (1S953)	
Q 29	IC, (μPC71A)	
Q 30	Di, Si, (1S953)	
Q 31	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 32	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 33	IC, (μPC71A)	
Q 34	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 35	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 36	Di, Si, (1S953)	
Q 37	IC, (μPC71A)	
Q 38	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 39	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 40	IC, (μPC71A)	
Q 41	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 42	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 43	IC, CμPC71A)	
Q 44	IC, (SN74LS14N)	
Q 45	IC, (75451)	
Q 46	IC, (75451)	
Q 47	IC, (75451)	
Q 48	IC, (SN7406N)	
Q 49	IC, (μPC251A)	
Q 50	IC, (μPC251A)	
Q 51	Di, breakdown, (RD9AM)	8.3to9.2V, 0.4W
Q 52	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 53	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 54	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 55	Tr, Si, NPN, (2SD79KL)	
Q 56	Di, brakdown, (RD6.2EB)	5.8to6.6V, 0.4W
Q 57	Di, breakdown, (RD6.2EB)	5.8to6.6V, 0.4W
Q 58	Di, breakdown, (RD6.2EBB)	5.8to6.6V, 0.4W
L 1	Coil, (SF-T8-50S)	72μH
R 1	Res, Var, CT, (RJ-6P 202)	2kΩ, ± 20%, 0.5W
R 2	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 3	Res, CF, (ARD25T104J)	100kΩ, ± 5%, 0.25W
R 4		
R 5	Res, Var, CT, (RJ-6P 202)	2kΩ, ± 20%, 0.5W
R 6	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 7	Res, CF, (ARD25T104J)	100kl, ± 5%, 0.25W
R 8		
R 9		
R 10	Res, Var, CT, (RJ-6P203)	20kΩ, ± 20%, 0.5W
R 11	Res, Var, CT, (RJ-6P202)	2kΩ, ± 20%, 0.5W
R 12	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 13	Res, CF, (ARD25T104J)	100kΩ, ± 5%, 0.25W
R 14		

CKT REF	DESCRIPTION	RATING
R 15		
R 16	Res, Var, CT, (RJ-6P203)	20kΩ, ± 20%, 0.5W
R 17	Res, Var, CT, (RJ-6P202)	2kΩ, ± 20%, 0.5W
R 18	Res, CF, (ARD25T 102J)	1kΩ, ± 5%, 0.25W
R 19	Res, CF, (ARD25T104J)	100kΩ, ± 5%, 0.25W
R 20		
R 21		
R 22	Res, Var, CT, (RJ-6P203)	20kΩ, ± 20%, 0.5W
R 23	Res, Var, CT, (RJ-6P202)	2kΩ, ± 20%, 0.5W
R 24	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 25	Res, CF, (ARD25T104J)	100kΩ, ± 5%, 0.25W
R 26		
R 27		
R 28	Res, Var, CT, (RJ-6P 203)	20kΩ, ± 20%, 0.5W
R 29	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 30	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 31	Res, CF, (ARD25T470J)	47Ω, ± 5%, 0.25W
R 32	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 33	Res, CF, (ARD25T703J)	10kΩ, ± 5%, 0.25W
R 34	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 35	Res, CF, (ARD25T470J)	47Ω, ± 5%, 0.25W
R 36	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 37	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 38	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 39	Res, CF, (ARD25T470J)	47Ω, ± 5%, 0.25W
R 40	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 41	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 42	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 43	Res, CF, (ARD25T470J)	47Ω, ± 5%, 0.25W
R 44	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 45	Res, CF, (ARD25T202J)	2kΩ, ± 5%, 0.25W
R 46	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 47	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 48	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 49	Res, Var, CT, (RJ-6P102)	1kΩ, ± 20%, 0.5W
R 50	Res, CF, (ARD25T152J)	1.5kΩ, ± 5%, 0.25W
R 51	Res, CF, (ARD25T202J)	2kΩ, ± 5%, 0.25W
R 52	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 53	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 54	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 55	Res, CF, (ARD25T103J)	10kΩ, ± 5%, 0.25W
R 56	Res, Var, CT, (RJ-6C102)	1kΩ, ± 20%, 0.5W
R 57	Res, CF, (ARD25T152J)	1.5kΩ, ± 5%, 0.25W
R 58	Res, CF, (ARD25T202J)	2kΩ, ± 5%, 0.25W
R 59	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 60	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 61	Res, Var, CT, (RJ-6P102)	1kΩ, ± 20%, 0.5W
R 62	Res, CF, (ARD25T152J)	1.5kΩ, ± 5%, 0.25W
R 63	Res, CF, (ARD25T202J)	2kΩ, ± 5%, 0.25W
R 64	Res, CF, (ARD25T102J)	1kΩ, ± %, 0.25W
R 65	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 66	Res, Var, CT, (RJ-6P102)	1kΩ, ± 20%, 0.5W
R 67	Res, CF, (ARD25T152J)	1.5kΩ, ± 5%, 0.25W
R 68	Res, CF, (ARD25T202J)	2kΩ, ± 5%, 0.25W
R 69	Res, CF, (ARD25T102J)	1kΩ, ± 5%, 0.25W
R 70	Res, CF, (ARD25T105J)	1MΩ, ± 5%, 0.25W
R 71	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W
R 72	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W
R 73	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W
R 74	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W
R 75	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W
R 76	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W
R 77	Res, CF, (ARD25T222J)	2.2kΩ, ± 5%, 0.25W
R 78	Res, CF, (ARD25T222J)	2.2kΩ, ± 5%, 0.25W
R 79	Res, CF, (ARD25T222J)	2.2kΩ, ± 5%, 0.25W

CKT REF	DESCRIPTION	RATING
R 80	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 81	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 82	Not Assigned	
R 83	Not Assigned	
R 84	Res, CF, (ARD25T121J)	120Ω, ±5%, 0.25W
R 85	Res, CF, (ARD25T121J)	120Ω, ±5%, 0.25W
R 86	Res, CF, (ARD25T471J)	470Ω, ±5%, 0.25W
R 87	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 88	Res, CF, (ARD25T330J)	33Ω, ±5%, 0.25W
R 89	Res, CF, (ARD25T330J)	33Ω, ±5%, 0.25W
R 90	Res, Var, CT, (RJ-6P202)	2kΩ, ±20%, 0.5W
R 91	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 92	Res, CF, (ARD25T202J)	2kΩ, ±5%, 0.25W
R 93	Res, MF, (RN14K2E2001D)	2kΩ, ±0.5%, 0.25W
R 94	Res, MF, (RN14K2E3011D)	3.01kΩ ±0.5%, 0.25W
R 95	Res, MF, (RN14K2E1001D)	1kΩ, ±0.5%, 0.25W
R 96	Res, Var, CT (RJ-6S 102)	1kΩ, ±20%, 0.5W
R 97	Res, MF, (RN14K2E2212D)	22.1kΩ, ±0.5%, 0.25W
R 98	Res, MF, (RN14K2E2212D)	22.1kΩ, ±0.5%, 0.25W
R 99	Res, CF, (ARD25T331J)	330Ω, ±5%, 0.25W
R 100	Res, CF, (ARD25T470J)	47Ω, ±5%, 0.25W
R 101	Res, Var, CT (RJ-6P202)	2kΩ, ±20%, 0.5W
R 102	ResKAMF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 103	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 104	Res, MF, (RN14K2E1692D)	16.9kΩ, ±0.5%, 0.25W
R 105	Res, MF, (RN14K2E2212D)	22.1kΩ, ±0.5%, 0.25W
R 106	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 107	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 108	Res, CF, (ARD25T470J)	47Ω, ±5%, 0.25W
R 109	Res, CF, (ARD25T822J)	8.2kΩ, ±5%, 0.25W
R 110	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 111	Res, Var, CT (RJ-6P203)	20kΩ, ±20%, 0.5W
R 112	Res, CF, (ARD25T471J)	470Ω, ±5%, 0.25W

TABLE 5-4 A2 PROCESSING UNIT

E 1	Terminal, (A12 Rikugun-tanshi)	
E 2	Terminal, (A12 Rikugun-tanshi)	
E 3	Terminal, (A12 Rikugun-tanshi)	
F 1	Fuse, (MF61NN 250V 2AAC05)	2A, 250V
F 2	Fuse, (MF61NN 250V1AAC05)	1A, 250V
J 1	Inter Connector, (U-SB1503)	
J 2	Inter Connector, (U-SA1003)	
J 3	Inter Connector, (U-SB2203)	
J 4	Inter Connector, (U-SB2203)	
J 5	Inter Connector, (U-SB1503)	
J 6	Not Assigned	
J 7	Not Assigned	
J 8	Not Assigned	
J 9	Not Assigned	
J 10	Not Assigned	
J 11	Plug, (FAS-34-03)	
J 12	Plug, (FAS-34-03)	
J 13	Plug, (FAS-34-03)	
J 14	Receptacle, (FBP-34-041)	
J 15	Not Assigned	
J 16	Not Assigned	
J 17	Not Assigned	
J 18	Not Assigned	
J 19	Not Assigned	
J 20	Not Assigned	
J 21	Plug, (CN-1603RJ)	
J 22	Connector, (PRCO3-21A10-3AF)	
J 23	Receptacle, (S-1334B-ST)	
J 24	Receptacle, (RM15QR-8S)	
J 25	Receptacle, (RM15QR-8P)	
J 26	Receptacle, (RM15QR-10S)	
M 1	Meter, (54M13748)	±10V
M 2	Meter, (54M13749)	±10V
M 3	Meter, (54M13750)	±10V
M 4	Hour Meter, (TM-O)	
Q 1	LED, (BD-801RG)	
Q 2	LED, (BD-701R)	
Q 3	LED, (BD-701R)	
R 1	Res, MF, (MFA2.495kΩBT12)	2.495kΩ, ±0.1%, 1/8W
R 2	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 3	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 4	Res, MF, (MFA20kΩAT12)	20kΩ, ±0.05%, 1/8W
R 5	Res, MF, (MFA25kΩAT12)	25kΩ, ±0.05%, 1/8W
R 6	Res, MF, (MFA50kΩBT1)	50kΩ, ±0.1%, 1/8W
R 7	Res, MF, (MFA100kΩCT2)	100kΩ, ±0.25%, 1/8W
R 8	Res, MF, (MFA200kΩDT3)	200kΩ, ±0.5%, 1/8W
R 9	Res, MF, (MFA250kΩDT3)	250kΩ, ±0.5%, 1/8W
R 10	Res, MF, (MFA500kΩDT3)	500kΩ, ±0.5%, 1/8W
R 11	Res, MG, (GS-½A 1MΩF)	1MΩ, ±1%, 0.5W
R 12	Res,MG, (GS-½A 2MΩG)	2MΩ, ±2%, 0.5W
R 13	Not Assigned	
R 14	Not Assigned	
R 15	Not Assigned	
R 16	Not Assigned	
R 17	Not Assigned	
R 18	Not Assigned	
R 19	Not Assigned	
R 20	Res, Var, WW, (M-2205 200Ω)	200Ω, ±5%, 2W
R 21	Res, Var, WW, (M-2205 10kΩ)	10kΩ, ±5%, 2W
R 22	Res, CF, (ARD25T473J)	47kΩ, ±5%, 0.25W
R 23	Res, CF, (ARD25T473J)	47kΩ, ±5%, 0.25W
R 24	Res, MF, (RN14K2E2002D)	20kΩ, ±0.5%, 0.25W
R 25	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
S 1	Toggle Sw, (8B2011)	
S 2	Rotary Sw, (26M1-2-4)	
S 3	Multi Sw, (54S11798)	
S 4	Toggle Sw, (8A1011)	
U 1	Output circuit (58W34)	
U 2	Counter Circuit (53W4099)	
U 3	Display Circuit (54W13717)	
U 4	Relay Circuit (54W13747)	
Z 1	Filter, (MC-2020)	
Z 2	Power Supply, (53W4340)	0.4A±15V, 1.5A+23V

TABLE 5-5 U1 OUTPUT CIRCUIT

C 1	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 2	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 3	Cap, Plast, (ECQ-M05153KZ)	0.015μF, ±10%, 50V
C 4	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 5	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V

CKT REF	DESCRIPTION	RATING
C 6	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 7	Not Assigned	
C 8	Not Assigned	
C 9	Cap, Tant, (CS02H1V1R0M)	1μF, +20%, 35V
C 10	Cap, Plast(CQ08S1H10001K03)	0.01μF, ±10%, 50V
C 11	Cap, Plast, (CQ08S1H10001K03)	0.01μF, ±10%, 50V
C 12	Cap, Plast, (CQ08S1H10001K03)	C0.01μF, ±10%, 50V
C 13	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 14	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 15	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80%−20%, 25V
C 16	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 17	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 18	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 19	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 20	Not Assigned	
C 21	Not Assigned	
C 22	Not Assigned	
C 23	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 24	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
CC 25	Cap, Plast, (SFA-6000-2.5-25)	6000PF, ±2.5%, 25V
C 25	Cap, Pllast, (SFA-6000-2.5-25)	6000PF, ±2.5%, 25V
C 26	Cap, Plast, (SFA-6000-2.5-25)	6000PF, ±2.5%, 25V
C 27	Cap, Plast, (ECQ-M05473KZ)	0.047μF, ±10%, 50V
C 28	Cap, Plast, (ECQ-M05223KZ)	0.022μF, ±10%, 50V
C 29	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 30	Cap, Plast, (SFA-16900-2.5-25)	16900PF, ±2.5%, 25V
C 31	Cap, Plast, (SFA-16900-2.5-25)	16900PF, ±2.5%, 25V
C 32	Cap, Plast, (SFA-6000-2.5-25)	6000PF, ±2.5%, 25V
C 33	Cap, plast, (SFA-60-2.5-25)	6000PF, ±2.5%, 25V
C 34	Cap, Plast, (SFA-8000-2.5-25)	8000PF, ±2.5%, 25V
C 35	Cap, Plast, (SFA-8000-2.5-25)	8000PF, ±2.5%, 25V
C 36	Cap, Plast, (ECQ-M05474KZ)	0.47μF, ±10%, 50V
C 37	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 38	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 39	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 40	Cap, Cer, (ECKD1E104ZFZ)	0.1μ1F, +80/−20%, 25V
C 41	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%,25V
C 42	CCap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 43	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 44	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 45	Cap, Plast, (CQ08S2B47000G02)	4700PF, ±2%, 125V
C 46	Cap, Plast, (CQ08S2B47000G02)	4700PF, ±2%, 125V
C 47	Cap, Plast, (CQ08S1H10001K03)	10000PF, ±10%, 50V
C 48	Cap, Plast, (CQ08S1H10001K03)	10000PF, ±10%, 50V
C 49		
C 50		
C 51	Cap, plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 52		
C 53		
C 54	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 55	Cap, Plast, (ECQ-M05473KZ)	0.047μF, ±10%, 50V
C 56	Cap, Plast, (ECQ-M05223KZ)	0.022μF, ±10%, 50V
C 57	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 58	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 59	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 60	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 61	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 62	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 63	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 64	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 65	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 66	Not Assigned	
C 67	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 68		
C 69		

CKT REF	DESCRIPTION	RATING
C 70	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 71		
C 72		
C 73	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 74	Cap, Plast, (ECQ-M05104KZ)	0 1μF, ±10%, 50V
C 75	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 76		
C 77		
C 78	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 79		
C 80		
C 81	Cap, Plast, (ECQ-M05473KZ)	0.047μF, ±10%, 50V
C 82	Cap, Plast, (ECQ-M05223KZ)	0.022μF, ±10%, 50V
C 83	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 84	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 85	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 86	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 87	Not Assigned	
C 88	Cap, Plast, (ECQ-M05473KZZ)	0.047μF, ±10%, 50V
C 89	Cap, Plast, (ECQ-M05223KZ)	0.022μF, ±10%, 50V
C 90	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 91	Cap, Plast, (ECQ-M05103KZ)	0 01μF, ±10%, 50V
C 92	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 93	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 94	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 95	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 96	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 97	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 98	Not Assigned	
C 99	Not Assigned	
C 100	Not Assigned	
C 101	Cap, Plast, (ECQ-M05473KZ)	0.047μF, ±10%, 50V
C 102	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 103	Cap, Tant, (CS02H1D2R2M)	2.2μF, ±20%, 20V
C 104	Cap, Tant, (CS02H1V010M)	1μF, ±20%, 35V
C 105	Cap, Elect, (CE04W1C330)	33μF, +100/−10%, 16V
C 106	Cap, Elect, (CE04W1C330)	33μF, +100/−10%, 16V
C 107	Cap, Plast, (ECQ-M05223KZ)	0.022μF, ±10%, 50V
C 108	Cap, Cer, (ECKDD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 109	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 110	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 111	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 112	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 113	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 114	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 115	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 116	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 117	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 118	Cap, Plast, (ECQ-M05223KZ)	0.022μF, ±10%, 50V
C 119	Not Assigned	
C 120	Not Assigned	
C 121	Cap, Plast, (ECQ-M05472KZ)	4700PF, ±10%, 50V
C 122	Cap, Plast, (ECQ-M05472KZ)	4700PF, ±10%, 50V
C 123	Cap, Plast, (ECQ-M05472KZ)	4700PF, ±10%, 50V
C 124	Cap, Plast, (ECQ-M05472KZ)	4700PF, ±10%, 50V
C 125	Cap, Plast, (ECQ-M05473KZ)	0.047μF ±10%, 50V
C 126	Cap, Plast, (EEQ-M05472KZ)	4700PF±10%, 50V
C 127	Cap, Plast, (ECQ-M05102KZ)	1000PF ±10%, 50V
C 128	Cap, Plast, (ECQ-M05223KE)	0.022μF ±10%, 50V
C 129	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 130	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 131	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 132	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V
C 133	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +00/−20%, 16V

CKT REF	DESCRIPTION	RATING
C 134	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞−20%, 16V
C 135	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 136	Cap, Tant, (CS02H1D150M)	15μF, ±20%, 20V
C 137	Cap, Cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
C 138	Cap, cer, (ECKD1E104ZFZ)	0.1μF, +80/−20%, 25V
E 1	Terminal, (P), (34J55599)	
E 2	Terminal, (P), (34J55599)	
E 3	Terminal, (P), (34J55599)	
E 4	Terminal, (P), (34J5599)	
E 4	Terminal, (P), (34J55599)	
E 5	Terminal, (P), (34J55599)	
E 6	Terminal, (P), (34J55599)	
E 7	Terminal, (P), (34J55599)	
E 8	Terminal, (P), (34J55599)	
E 9	Terminal, (P), (34J55599)	
E 10	Terminal, (P), (34J55599)	
E 11	Terminal, (P), (34J55599)	
E 13	Terminal, (P), (34J55599)	
E 14	Terminal, (P), (34J55599)	
E 15	Terminal, (P), (34J55599)	
E 16	Terminal, (P), (34J55599)	
E 17	Terminal, (P), (34J55599)	
E 18	Terminal, (P), (34J55599)	
E 19	Terminal, (P), (34J55599)	
E 20	Terminal, (P), (34J55599)	
E 21	Terminal, (P), (34J55599)	
E 22	Terminal, (P), (34J55599)	
E 23	Not Assigned	
E 24	Not Assigned	
E 25	Not Assigned	
E 26	Terminal, (P), (34J55599)	
E 27	Terminal, (P), (34J55599)	
E 28	Terminal, (P), (34J55599)	
J 1	Inter connector, (U-PB1521)	
J 2	Inter connector, (U-PA1021)	
J 3	Inter connector, (U-PB2221)	
J 4	Inter connector, (U-PB2221)	
J 5	Inter connector, (U-PB1521)	
J 6	Not Assigned	
J 7	Not Assigned	
J 8	Not Assigned	
J 9	Not Assigned	
J 10	Inter Connector, (U-SB1550)	
J 11	Terminal, (J), (34J55600)	
J 12	Terminal, (P), (34J55599)	
J 13	Terminal, (P), (34J55599)	
J 14	Terminal, (J), (34J55600)	
J 15	Terminal, (P), (34J55599)	
J 16	Terminal, (P), (34J55599)	
J 17	Not Assigned	
J 18	Not Assigned	
Q 1	Di, breakdown, (RD11EB)	10.4to11.6v, 0.4W
Q 2	IC, (μPC251A)	
Q 3	Di, Si(1S953)	
Q 4	Di, Si(1S953)	
Q 5	IC, (μPC71A)	
Q 6	Di, breakdown, (RD4AM)	3.7to4.8V, 0.25W
Q 7	Di, breakdown, (RD4AM)	3.7to4.8V, 0.25W
Q 8	Di, breakdown, (RD6.2EB)	5.8to6.6V, 0.4W
Q 9	Di, breakdown, (RD6.2EB)	5.8to6.6V, 0.4W
Q 10	Di, breakdown, (RD6.2EB)	5.8to 6.6V, 0.4W

CKT REF	DESCRIPTION	RATING
Q 11		
Q 12	Di, breakdown, (RD6.2EB)	5.8to6.6V, 0.4W
Q 13	Di, Si, (1S953)	
Q 14	Di, Si, (1S953)	
Q 15	Tr, Si, NPN, (2SC943KL)	
Q 16	IC, (μA741E)	
Q 17	Di, Si, (1S953)	
Q 18	Di, Si, (1S953)	
Q 19	Sample & Hold, (SHM-LM-2)	
Q 20	Di, breakdown, (RD11AM)	9.9to11.0V, 0.25W
Q 21	IC, (μA741E)	
Q 22	Sample & Hold, (SHM-LM-2)	
Q 23	Sample & Hold, (SHM-LM-2)	
Q 24	Di, breakdown, (RD9.1EB)	8.5to9.6V, 0.4W
Q 25	Not Assigned	
Q 26	Not Assigned	
Q 27	Photo Coupler LEDCDS, (P873-G35-20(B)	
Q 28	IC, (μPC251A)	
Q 29	IC, (μPC251A)	
Q 30	IC, (μPC251A)	
Q 31	IC, (μPC251A)	
Q 32	Di, breakdown, (RD5 1EB)	4.8to5.4V, 0.4W
Q 33	Di, breakdown, (RD5 1EB)	4.8to5.4V, 0.4W
Q 34	Sample & Hold, (SHM-IC-1)	
Q 35	Sample & Hold, (SHM-IC-2)	
Q 36	Sample & Hold, (SHM-IC-2)	
Q 37	Sample & Hold, (SHM-IC-2)	
Q 38	IC, (μA741E)	
Q 39	IC, (μA741E)	
Q 40	IC, (μPC154A)	
Q 41		
Q 42		
Q 43	Di, Si, (1S953)	
Q 44	Di, Si, (1S953)	
Q 45		
Q 46		
Q 47	Di, breakdoun, (1SZ53)	6.5V, 7.5mA
Q 48	Tr, Si, NPN, (2SC943KL)	
Q 49	Di, Si, (1S953)	
Q 50	Di, Si, (1S953)	
Q 51	IC, (μA741E)	
Q 52	IC, (μA741E)	
Q 53	IC, (μA741E)	
Q 54	IC, (μA741E)	
Q 55	IC, (μPC154A)	
Q 56		
Q 57		
Q 58		
Q 59		
Q 60		
Q 61		
Q 62		
Q 63		
Q 64	Di, Si, (1S953)	
Q 65	Di, Si, (1S953)	
Q 66	Not Assigned	
Q 67	Not Assigned	
Q 68	Not Assigned	
Q 69	Not Assigned	
Q 70	Not Assigned	
Q 71	IC, (VF530)	
Q 72	IC, (μPC154A)	
Q 73	Sample & Hold, (AD7513JH)	

Q 74	IC, (μPC151A)	
Q 75	IC, (μPC151A)	
Q 76	IC, (μPC151A)	
Q 77	Di, Si, (1S953)	
Q 78	Di, Si, (1S953)	
Q 79	Di, Si, (1S953)	
Q 80	Di, Si, (1S953)	
Q 81	Di, breakdown, (RD5AN)	4.9to5.4V, 0.25W
Q 82	Di, breakdown, (RD5AN)	4.9to5.4V, 0.25W
Q 83	Di, Si, (1S953)	
Q 84	Di, Si, (1S953)	
Q 85	Di, Si, (1S953)	
Q 86	Di, Si, (1S953)	
Q 87	Di, Si, (1S953)	
Q 88	Di, Si, (1S953)	
Q 89	Di, breakdown, (RD11EB)	10.4to11.6V, 0.4W
Q 90	Di, breakdown, (RD11EB)	10.4to11.6V, 0.4W
Q 91	Di, breakdown, (RD11EB)	10.4to11.6V, 0.4W
Q 92	Di, breakdown, (RD11EB)	10.4to11.6V 0.4W
Q 93	IC, (μPC251A)	
Q 94	IC, (μPC251A)	
Q 95	IC, (μPC251A)	
Q 96	IC, (μPC251A)	
Q 96	IC, (μPC251A)	
Q 97	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 98	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 99	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 100	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 101	Di, Si, (1S953)	
Q 102	Di, Si, (1S953)	
Q 103	Di, Si, (1S953)	
Q 104	Di, Si, (1S953)	
Q 105	Di, Si, (1S953)	
Q 106	IC, (μPC251A)	
Q 107	IC, (μPC251A)	
Q 108	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 109	Di, breakdown, (RD5.1EB)	4.8to5.4V, 0.4W
Q 110	Di, breakdown, (RD11EB)	10.4to11.6V, 0.4W
Q 111	Di, breakdown, (RD11EB)	10.4to11.6V, 0.4W
Q 112	Di, Si, (1S953)	
Q 113	Di, Si, (1S953)	
Q 114	Not Assigned	
Q 115	Not Assigned	
Q 116	Not Assigned	
Q 117	Not Assigned	
Q 118	Not Assigned	
Q 119	Not Assigned	
Q 120	Not Assigned	
Q 121	IC, (SN7406N)	
Q 122	IC, (SN74LS86N)	
Q 123	IC, (SN74LS00N)	
Q 124	IC, (SN74221N)	
Q 125	IC, (SN74221N)	
Q 126	IC, (SN74221N)	
Q 127	IC, (SN74221N)	
Q 128	IC, (SN74LS74N)	
Q 129	IC, (SN74LS00N)	
Q 130	IC, (SN74LS157N)	
Q 131	IC, (SN74LS74N)	
Q 132	IC, (SN74LS04N)	
Q 133	IC, (SN74LS74N)	
Q 134	IC, (SN74LS00N)	
Q 135	IC, (SN74LS132N)	
Q 136	IC, (SN7406N)	
Q 137	IC, (SN74LS132N)	
Q 138	IC, (SN74LS10N)	
Q 139	IC, (SN74LS00N)	
Q 140	IC, (SN74LS04N)	
Q 141	IC, (SN7400N)	
Q 142	IC, (SN7406N)	
Q 143	IC, (SN7406N)	
R 1	Res, MF, (RN14K2E1001D)	1kΩ, ±0.5%, 0.25W
R 2	Res, MF, (RN14K2E1001D)	1kΩ, ±0.5%, 0.25W
R 3	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 4	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 5	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 6	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 7	Res, MF, (RN14K2E2002D)	20kΩ, ±0.5%, 0.25W
R 8	Res, MF, (RN14K2E2002D)	20kΩ, ±0.5%, 0.25W
R 9	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 10	Res, CF, (ARD25T221J)	220Ω, ±5%, 0.25W
R 10	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 12	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 13	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 14	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 15	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 16	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 17	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 18	Res, CF, (ARD25T221J)	220Ω, ±5%, 0.25W
R 19	Res, CF, (ARD25T561J)	560Ω, ±5%, 0.25W
R 20	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 21	Res, CF, (ARD25T473J)	47kΩ, ±5%, 0.25W
R 22	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 23	Res, CF, (ARD25T332J)	3.3kΩ, ±5%, 0.25W
R 24	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 25	Res, CF, (ARD25T473J)	47kΩ, ±5%, 0.25W
R 26	Res, Var, CT, (RJ-6P502)	5kΩ, ±20%, 0.5W
R 27	Not Assigned	
R 28	Not Assigned	
R 29	Res, MF, (MFA8kΩBT12)	8kΩ, ±0.1%, 1/8W
R 30	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 31	Res, Var, WW, (K-9W1kΩ)	1kΩ, ±5%, 0.5W
R 32	Res, CF, (ARD25T561J)	560Ω, ±5%, 0.25W
R 33	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 34	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 35	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 36	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 37	Res, CF, (ARD25T473J)	47kΩ, ±5%, 0.25W
R 38	Res, CF, (ARD25T512J)	5.2kΩ, ±5%, 0.25W
R 39	Not Assigned	
R 40	Not Assigned	
R 41	Not Assigned	
R 42	Not Assigned	
R 43	Not Assigned	
R 44	Not Assigned	
R 45	Not Assigned	
R 46	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 47	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 48	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 49	Res, MF, (RN14K2E1692D)	16.9kΩ, ±0.5%, 0.25W
R 50	Res, MF, (RN14K2E2212D)	22.1kΩ, ±0.5%, 0.25W
R 51	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 52	Res, CF, (ARD25T224J)	220kΩ, ±5%, 0.25W
R 53	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 54	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 55	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 56	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W

R 57	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 58	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 59	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 60	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 61	Res, MF, (RN14K2E6811D)	6.81kΩ, ±0.5%, 0.25W
R 62	Res, MF, (RN14K2E1542D)	15.4kΩ, ±0.5%, 0.25W
R 63	Res, MF, (RN14K2E8251D)	8.25kΩ, ±0.5%, 0.25W
R 64	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 65	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 66	Res, MF, (RN14K2E4422D)	44.2KΩ, ±0.5%, 0.25W
R 67	Res, MF, (RN14K2E4422D)	44.2kΩ, ±0.5%, 0.25W
R 68	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 69	Res, MF, (RN14K2E1542D)	15.4kΩ, ±0.5%, 0.25W
R 70	Res, CF, (ARD25T221J)	220Ω, ±5%, 0.25W
R 71	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 72	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 73	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 74	Res, CF, (ARD25T153J)	15kΩ, ±5%, 0.25W
R 75	Res, CF, (ARD25T153J)	15kΩ, ±5%, 0.25W
R 76	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 77	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 78	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 79	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 80	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 81		
R 82		
R 83	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 84	Res, MF, (MFA1.07kΩDT1)	1.07kΩ, ±0.5%, 1/8W
R 85	Res, MF, (MFA8kΩBT12)	8kΩ, ±0.1%, 1/8W
R 86	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 87	Res, Var, WW, (K-9W1kΩ)	1kΩ, ±5%, 0.5W
R 88	Res, Var, CT, (RJ-6P101)	100Ω, ±20%, 0.5W
R 89		
R 90		
R 91	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 92	Res, CF, (ARD25T100J)	10Ω, ±5%, 0.25W
R 93	Res, CF, (ARD25T390J)	39Ω, ±5%, 0.25W
R 94	Res, MF, (MFA2.495kΩBT12)	2.495kΩ, ±0.1%, 1/8W
R 95	Res, Var, CT, (RJ-6P104)	100kΩ, ±20%, 0.5W
R 96	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 97	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.7%, 1/8W
R 98	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 99	Res, Var, CT, (RJ-6P101)	100Ω, ±20%, 0.5W
R 100		
R 101		
R 102		
R 103		
R 104	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 105	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 106	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 107	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 108	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 109	Res, MF, (MFA9.95kΩBT12)	9.95kΩ1, ±0.1%, 1/8W
R 110	Res, MF, (RN14K2E1102D)	11kΩ, ±0.5%, 0.25W
R 111	Res, MF, (RN14K2E1102D)	11kΩ, ±0.5%, 0.25W
R 112	Res, CF, (ARD257223J)	22kΩ, ±5%, 0.25W
R 113		
R 114		
R 115	Not Assigned	
R 116	Res, CF, (ARD25T104J)	100kΩ, ±5%, 0.25W
R 117	Res, CF, (ARD25T104J)	100kΩ, ±5%, 0.25W
R 118	Res, CF, (ARD25T223J)	22kΩ, ±5%, 0.25W
R 119	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 120	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 121	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 122	Res, Var, WW, (K-9W1kΩ)	1kΩ, ±5%, 0.5W
R 123	Res, MF, (MFA4.98kΩBT12)	4.98kΩ, ±0.1%, 1/8W
R 124	Res, MF, (MFA 8kΩBT12)	8kΩ, ±0.1%, 1/8W
R 125	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 126		
R 127		
R 128	Res, CF, (ARD25T100J)	10Ω, ±5%, 0.25W
R 129	Res, CF, (ARD25T390J)	39Ω, ±5%, 0.25W
R 130	Res, Var, CT, (RJ-6P 104)	100kΩ, ±20%, 0.5W
R 131	Res, Var, CT, (RJ-6P500)	50Ω, ±20%, 0.5W
R 132	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 133	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.7%, 1/8W
R 134	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 135	Res, CF, (ARD25T4R7J)	4.7Ω, ±5%, 0.25W
R 136	Res, MF, (RN14K2E25R5D)	25.5Ω, ±0.5%, 0.25W
R 137	Res, Var, CT, (RJ-6P100)	10Ω, ±20%, 0.5W
R 138	Res, Var, CT, (RJ-6P500)	50Ω, ±20%, 0.5W
R 139	Res, Var, CT, (RJ-6P101)	100Ω, ±20%, 0.5W
R 140	Not Assigned	
R 141	Not Assigned	
R 142	Not Assigned	
R 143	Res, Var, CT, (RJ-6P501)	500Ω, ±20%, 0.5W
R 144	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 145	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 146	Res, MF, (MFA500kΩDT)	500kΩ, ±0.5%, 1/8W
R 147	Res, Var, CT, (RJ-6P104)	100kΩ, ±20%, 0.5W
R 148	Res, CF, (ARD25T100J)	10Ω, ±5%, 0.25W
R 149	Res, CF, (ARD25T390J)	39Ω, ±5%, 0.25W
R 150	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 151	Res, CF, (ARD25T203J)	20kΩ, ±5%, 0.25W
R 152	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 153	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 154	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 155	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 156	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 157	Res, MF, (MFA9.95kΩBT12)	9.95kΩ, ±0.1%, 1/8W
R 158	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 159	Res, CF, (ARD25T512J)	5.1kΩ, ±5%, 0.25W
R 160	Res, Var, CT, (RJ-6P103)	10kΩ, ±20%, 0.5W
R 161	Res, Var, CT, (RJ-6P103)	10kΩ, ±20%, 0.5W
R 162	Res, Var, CT, (RJ-6P103)	10kΩ, ±20%, 0.5W
R 163	Res, CF, (ARD25T512J)	5.1kΩ, ±5%, 0.25W
R 164	Res, CF, (ARD25T101J)	100Ω, ±5%, 0.25W
R 165	Res, CF, (ARD25T333J)	33kΩ, ±5%, 0.25W
R 166	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 167	Res, CF,(ARD25T332J)	3.3kΩ, ±5%, 0.25W
R 168	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 169	Res, MF, (RN14K2E2002D)	20kΩ, ±0.5%, 0.25W
R 170	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 171	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 172	Res, MF, (RN14K2E2002D)	20kΩΩ, ±0.5%, 0.25W
R 173	Res, CF, (ARD25T332J)	3.3kΩ, ±5%, 0.25W
R 174	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 175	Res, CF, (ARD25T224J)	220kΩ, ±5%, 0.25W
R 176	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 177	Not Assigned	
R 178	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 179	Res, MF, (RN14K2E2002D)	20kΩ, ±0.5%, 0.25W
R 180	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 181	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 182	Res, CF, (ARD25T473J)	47kΩ, , ±5%, 0.25W
R 183	Res, CF, (ARD25T202J)	2kΩ, ±5%, 0.25W
R 184	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 185	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W

R 186	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 187	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 188	Res, CF, (ARD25T203J)	20kΩ, ±5%, 0.25W
R 189	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 190	Res, CF, (ARD25T152J)	1.5kΩ, ±5%, 0.25W
R 191	Res, CF, (ARD25T152J)	15kΩ, ±5%, 0.25W
R 192	Res, CF, (ARD25T203J)	20kΩ, ±5%, 0.25W
R 193	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 194	Res, CF, (ARD25T203J)	20kΩ, ±5%, 0.25W
R 195	Res, CF, (ARD25T203J)	20kΩ, ±5%, 0.25W
R 196	Res, CF, (ARD25T203J)	20kΩ, ±5%, 0.25W
R 197	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 198	Res, CF, (ARD25T474J)	470kΩ, ±5%, 0.25W
R 199	Res, CF, (ARD25T512J)	5.1kΩ, ±5%, 0.25W
R 200	Res, CF, (ARD25T332J)	3.3kΩ, ±5%, 0.25W
R 201	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 202	Res, CF, (ARD25T202J)	2kΩ, ±5%, 0.25W
R 203	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 204	Res, CF, (ARD25T332J)	3.3kΩ, ±5%, 0.25W
R 205	Res, CF, (ARD25T105J)	1MΩ, ±5%, 0.25W
R 206	Res, CF, (ARD25T512J)	5.1kΩ, ±5%, 0.25W
R 207	Res, CF, (ARD25T333J)	33kΩ, ±5%, 0.25W
R 208	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 209	Res, CF, (ARD25T102J)	1kΩ, ±5%, 0.25W
R 210	Res, MF, (RN14K2E1002D)	10kΩ, ±0.5%, 0.25W
R 211	Res, MF, (RN14K2E2002D)	20kΩ, ±0.5%, 0.25W
R 212	Res, Var, CT, (RJ-6P203)	20kΩ, ±20%, 0.5W
R 213	Not Assigned	
R 214	Not Assigned	
R 215	Not Assigned	
R 216	Not Assigned	
R 217	Not Assigned	
R 218	Not Assigned	
R 219	Not Assigned	
R 220	Not Assigned	
R 221	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 222	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 223	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 224	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 225	Res, CF, (ARD25T123J)	12kΩ, ±5%, 0.25W
R 226	Res, CF, (ARD25T123J)	12kΩ, ±5%, 0.25W
R 227	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 228	Res, CF, (ARD25T103J)	10kΩ, ±5%, 0.25W
R 229	Res, Var, CT, (RJ-6P502)	5kΩ, ±20%, 0.5W
R 230	Res, Var, CT, (RJ-6P502)	5kΩ, ±20%, 0.5W
R 231	Res, MF, (RN14K2H680J)	68Ω, ±5%, 0.5W
R 232	Res, MF, (RN14K2H680J)	68Ω, ±5%, 0.5W
R 233	Res, MF, (RN14K2H680J)	68Ω, ±5%, 0.5W
R 234	Res, MF, (RN14K2H680J)	68Ω, ±5%, 0.5W
R 235	Res, MF, (RN14K2H680J)	68Ω, ±5%, 0.5W
R 236	Res, CF, (ARD25T271J)	270Ω, ±5%, 0.25W
R 237	Res, CF, (ARD25T271J)	270Ω, ±5%, 0.25W
R 238	Res, CF, (ARD25T271J)	270Ω, ±5%, 0.25W
R 239	Res, CF, (ARD25T271J)	270Ω, ±5%, 0.25W
R 240	Not, Assigned	
R 241	Res, CF, (ARD25T202J)	2kΩ, ±0.5%, 0.25W

TABLE 5-6 U2 COUNTER CIRCUIT

C 1	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 2	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 3	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 4	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 5	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 6	Cap, Elect, (CA92C-1C-1R000-R56)	1μF, +∞/−20%, 16V
C 7	Not Assigned	
C 8	Not Assigned	
C 9	Cap, Cer, (ECCD1H101KC)	100PF, ±10%, 50V
C 10	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 11	Cap, Plast, (ECQ-M05102KZ)	1000PF, ±10%, 50V
C 12	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 13	Cap, Cer, (ECCD1H101KC)	100PF, ±10%, 50V
J 1	Terminal, (J), (34J55600)	
J 2	Not Assigned	
J 3	Not Assigned	
J 4	Not Assigned	
J 5	Not Assigned	
J 6	Not Assigned	
J 7	Not Assigned	
J 8	Not Assigned	
J 9	Not Assigned	
J 10	Inter Connector, (U-PB1519)	
J 11	Plug, (FAP-34-03#4)	
J 12	Not Assigned	
J 13	Plug, (FAP-34-03#4)	
L 1	Coil, (SF-T8-50S)	72μH
E 1	Terminal, (P), (34J55599)	
E 2	Terminal, (P), (34J55599)	
Q 1	IC, (SN74LS47N)	
Q 2	IC, (SN74LS47N)	
Q 3	IC, (SN74LS47N)	
Q 4	IC, (SN74LS47N)	
Q 5	IC, (SN7405N)	
Q 6	IC, (SN7405N)	
Q 7	IC, (SN7405N)	
Q 8	IC, (SN7438N)	
Q 9	IC, (SN74LS75N)	
Q 10	IC, (SN74LS75N)	
Q 11	IC, (SN74LS75N)	
Q 12	IC, (SN74LS75N)	
Q 13	IC, (SN74LS74AN)	
Q 14	IC, (SN74LS290N)	
Q 15	IC, (SN74LS290N)	
Q 16	IC, (SN74LS290N)	
Q 17	IC, (SN74LS290N)	
Q 18	IC, (SN74132N)	
Q 19	IC, (SN74LS04N)	
Q 20	IC, (SN74LS290N)	
Q 21	IC, (SN74LS290N)	
Q 22	IC, (SN74LS290N)	
Q 23	IC, (SN74LS290N)	
Q 24	IC, (SN74LS290N)	
Q 25	IC, (SN74LS123N)	
Q 26	IC, (SN7405N)	
R 1	Res, TF, (DIL-8C-270ΩRJ)	270Ω, ±5%, 0.15W
R 2	Res, TF, (DIL-8C-270ΩRJ)	270Ω, ±5%, 0.15W
R 3	Res, TF, (DIL-8C-270ΩRJ)	270Ω, ±5%, 0.15W
R 4	Res, TF, (DIL-8C-270ΩRJ)	270Ω, ±5%, 0.15W
R 5	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 6	Res, CF, (ARD25T222J)	2.2kΩ, ±5%, 0.25W
R 7	Res, CF, (ARD25T122J)	1.2kΩ, ±5%, 0.25W
R 8	Res, CF, (ARD25T122J)	1.2kΩ, ±5%, 0.25W
R 9	Res, CF, (ARD25T273J)	27kΩ, ±5%, 0.25W
R 10	Res, CF, (ARD25T121J)	120Ω, ±5%, 0.25W

CKT REF	DESCRIPTION	RATING
R 11	Res, CF, (ARD25T123J)	12kΩ, ±5%, 0.25W
X 1	Crystal (53X3098)	1MHZ

TABLE 5-7 U3 DISPLAY CIRCUIT

Q 1	LED, (SN713A)	
Q 2	LED, (SN713A)	
Q 3	LED, (SN713A)	
Q 4	LED, (SN713A)	
J 1	Not Assigned	
J 2	Not Assigned	
J 3	Not Assigned	
J 4	Not Assigned	
J 5	Not Assigned	
J 6	Not Assigned	
J 7	Not Assigned	
J 8	Not Assigned	
J 9	Not Assigned	
J 10	Not Assigned	
J 11	Plug, (FAP-34-03#4)	

TABLE 5-8 U4 RELAY CIRCUIT

C 1	Cap, Plast (ECQ-H6104KZ)	0.1μF, 630V
C 2	Cap, Plast (ECQ-H6104KZ)	0.1μF, 630V
E 1	Terminal, (P), (34J55599)	
E 2	Terminal, (P), (34J55599)	
E 3	Terminal, (P), (34J55599)	
E 4	Terminal, (P), (34J55599)	
E 5	Terminal, (P), (34J55599)	
E 6	Terminal, (P), (34J55599)	
E 7	Terminal, (P), (34J55599)	
K 1	Relay (MY-2-0DC24)	24V
K 2	Relay (MY-2-0DC24)	24V
Q 1	Di, Si, (1S953)	
Q 2	Di, Si, (1S953)	
R 1	Res, MF (RN14K2H151J)	150Ω, 0.5W
R 2	Res, MF (RN14K2H151J)	150Ω, 0.5W

TABLE 5-9 Z2 POWER SUPPLY

C 1	Cap, Elect, (ECEM35R3300E)	3300μF, +50/−10%, 35V
C 1	Cap, Elect, (ECEM35R3300E)	3300μF, +50/−10%, 35V
C 3	Cap, Elect, (ECEM25R103E)	10000μF, +50/−10%, 25V
C 4	Cap, Elect, (ECEM50R1000E)	1000μF, +50/−10%, 50V
C 5	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 6	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 7	Cap, Tant, (SSF104R7)	4.7μF, ±20%, 10V
C 8	Cap, Plast, (ECQ-M05102KZ)	1000PF, ±10%, 50V
C 9	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 10	Cap, Elect, (ECEA50V10L)	10μF, +50/−10%, 50V
C 11	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 12	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 13	Cap, Tant, (SSF104R7)	4.7μF, ±20%, 10V
C 14	Cap, Plast, (ECQ-M05102KZ)	1000PF, ±10%, 50V
C 15	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 16	Cap, Elect, (ECEA50V10L)	10μF, +50/−10%, 50V
C 17	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 18	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 19	Cap, Tant, (SSF104R7)	10μF, +50/−10%, 50V
C 20	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 21	Cap, Elect, (ECEA25V10L)	10μF, +50/−10%, 25V
C 22	Cap, Elect, (ECEA50V10L)	10μF, +50/−10%, 50V
C 23	Cap, Plast, (ECQ-M05103KZ)	0.01μF ±10%, 50V
C 24	Cap, Elect, (ECEA50V10L)	10μF, +50/−10%, 50V
C 25	Cap, Plast, (ECQ-M05103KZ)	0.01μF, ±10%, 50V
C 26	Cap, Plast, (ECQ-M05222KZ)	2200PF, ±10%, 50V
C 27	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 28	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 29	Cap, Plast, (ECQ-M05104KZ)	0.1μF, ±10%, 50V
C 30	Cap, Tant, (ECEA16V100L)	100μF, +50/−10%, 16V
J 1	Terminal, (LM-12P)	
J 2	Terminal, (LMS8P)	
Q 1	Di, Si, (V03C)	200V, 2A
Q 2	Di, Si, (V03C)	200V, 2A
Q 3	Di, Si, (V03C)	200V, 2A
Q 4	Di, Si, (V03C)	200V, 2A
Q 5	Tr, Si, NPN, (2SD297)	
Q 6	Tr, Si, PNP, (2SA603)	
Q 7	IC, (μPC141A)	
Q 8	Not Assigned	
Q 9	Di, Si, (V03C)	200V, 2A
Q 10	Di, Si, (V03C)	200V, 2A
Q 11	Di, Si, (V03C)	200V, 2A
Q 12	Di, Si, (V03C)	200V, 2A
Q 13	Tr, Si, NPN, (2SD297)	
Q 14	Tr, Si, PNP, (2SA603)	
Q 15	IC, (μPC141A)	
Q 16	Di, Si, (U05C)	200V, 4A
Q 17	Di, Si, (U05C)	200V, 4A
Q 18	Di, Si, (U05C)	200V, 4A
Q 19	Di, Si, (U05C)	200V, 4A
Q 20	Tr, Si, NPN, (2SD469)	
Q 21	Tr, Si, PNP, (2SA571)	
Q 22	IC, (μPC141A)	
Q 23	Di, Si, (V03C)	200V, 2A
Q 24	Di, Si, (V03C)	200V, 2A
Q 25	Di, Si, (V03C)	200V, 2A
Q 26	Di, Si, (V03C)	200V, 2A
Q 27	Tr, Si, NPN, (2SD297)	
Q 28	Tr, Si, NPN, (2SD78)	
Q 29	Di, breakdown, (RD12EB)	11.4to12.6V, 0.4W
Q 30	Tr, Si, NPN, (2SD78)	
R 1	Res, MF, (RS2B2.2ΩJ)	2.2Ω, ±5%, 2W
R 2	Res, CF, (ARD25T221J)	220Ω, ±5%, 0.25W
R 3	Res, CF, (ARD25T680J)	68Ω, ±5%, 0.25W
R 4	Res, CF, (ARD25T122J)	1.2kΩ, ±5%, 0.25W
R 5	Res, CF, (ARD25T153J)	15kΩ, ±5%, 0.25W
R 6	Res, Var, MF, (PNB04C3A102V)	1kΩ, ±20%, 1W

CKT REF	DESCRIPTION	RATING	CKT REF	DESCRIPTION	RATING
R [illegible]	Res, CF, (ARD25T182J)	1.8kΩ, ± 5%, 0.25W			
R [illegible]	Res, MF, (R-S2B2.2ΩJ)	2.2Ω, ± 5%, 2W			
R [illegible]	Res, CF, (ARD25T221J)	220Ω, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T680J)	68Ω, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T122J)	1.2kΩ, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T153J)	15kΩ, ± 5%, 0.25W			
R [illegible]	Res, Var, MF, (PNB04C3A102V)	1kΩ, ± 20%, 1W			
R [illegible]	Res, CF, (ARD25T182J)	1.8kΩ, ± 5%, 0.25W			
R [illegible]	Res, WW (RGB5L0.62ΩJ)	0.62Ω, ± 10%, 5W			
R [illegible]	Res, CF, (ARD25T221J)	220Ω, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T330J)	33Ω, ± 5%, 25W			
R [illegible]	Res, CF, (ARD25T221J)	220Ω, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W			
R [illegible]	Res, Var, MF, (PNB04C3A102A)	1kΩ, ± 20%, 1W			
R [illegible]	Res, CF, (ARD25T152J)	1.5kΩ, ± 5%, 0.25W			
R [illegible]	Not Assigned				
R [illegible]	Res, CF, (ARD25T461J)	560Ω, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T331J)	330Ω, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T332J)	3.3kΩ, ± 5%, 0.25W			
R [illegible]	Res, CF, (ARD25T392J)	3.9kΩ, ± 5%, 0.25W			
R [illegible]	Res, Var, MF, (PNB04C3A102V)	1kΩ, ± 20%, 1W			
R [illegible]	Res, CF, (ARD25T562J)	5.6kΩ, ± 5%, 0.25W			
R [illegible]	Not Assinged				
R [illegible]	Not Assinged				
R [illegible]	Res, CF (ARD25T121J)	120Ω, ± 5%, 0.25W			
R [illegible]	Res, CF (ARD25T472J)	4.7kΩ, ± 5%, 0.25W			
T [illegible]	Power Trans, (21-21A11)	56VA			
Z [illegible]	Spark Killer (S1201)				
Z [illegible]	Spark Killer (S1201)				

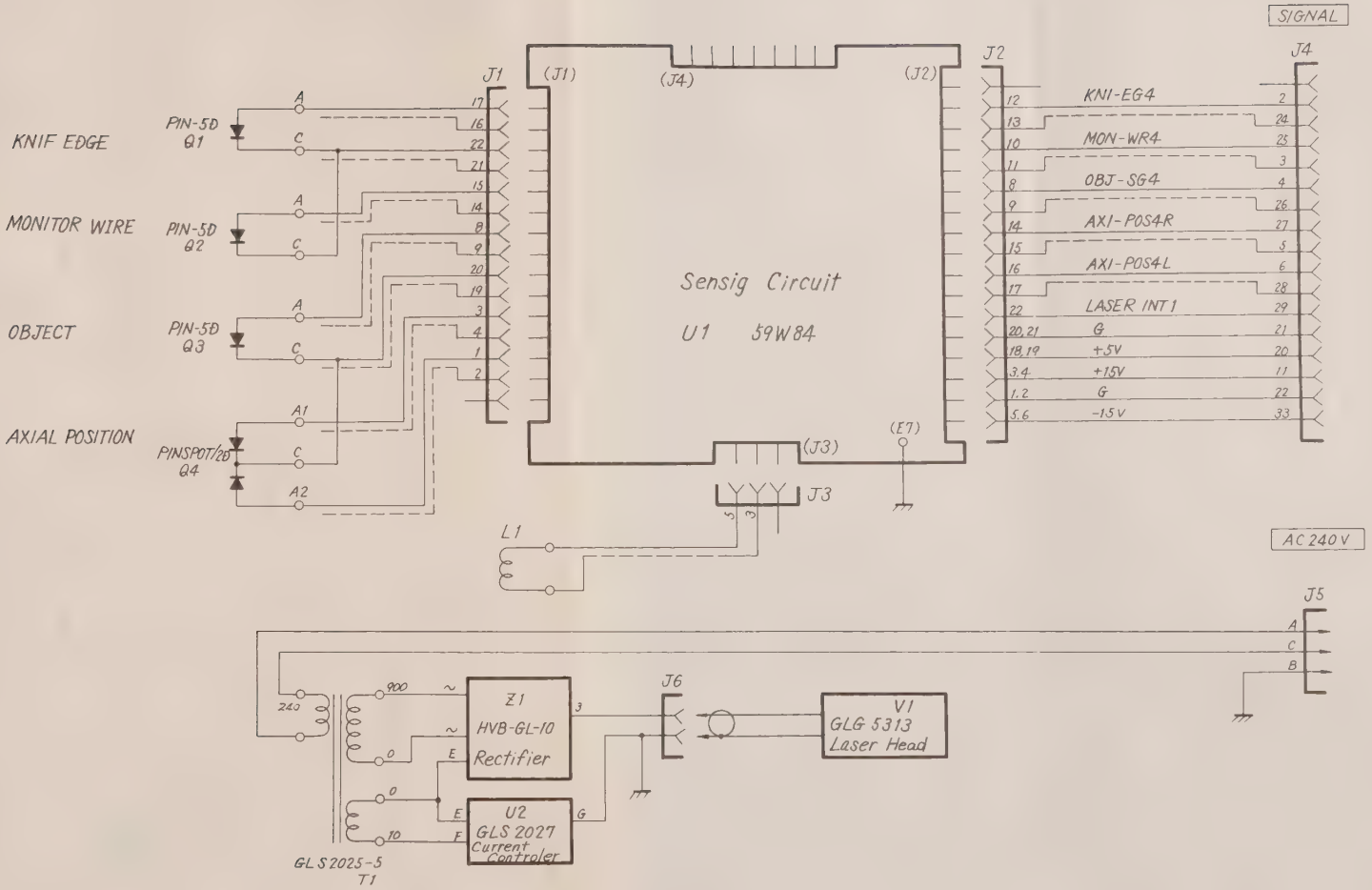


Fig. 5-1 Block Diagram of OPTICAL UNIT (53W4135)

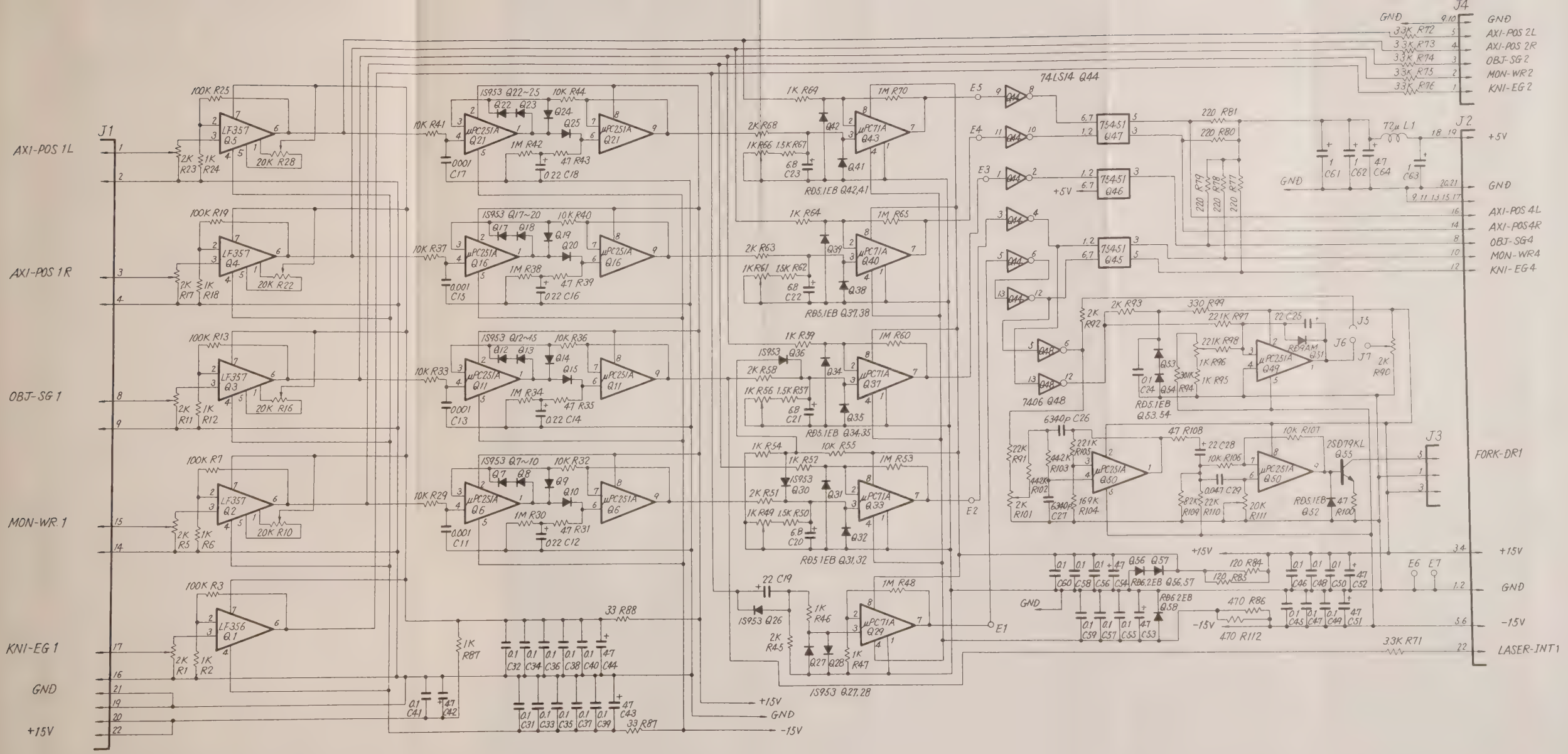


Fig. 5-2 OPTICAL UNIT U1 Sensing Circuit (59W84)

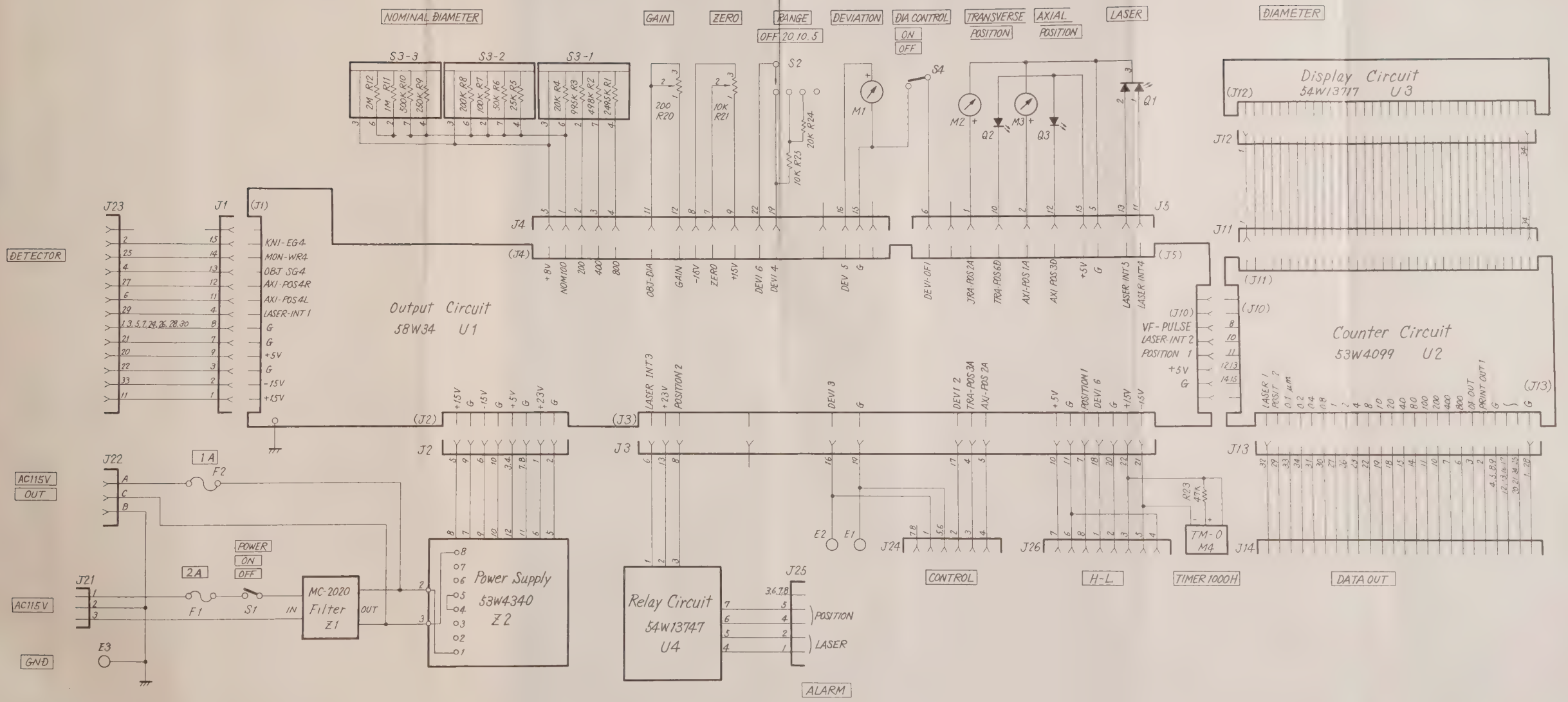


Fig. 5-3 Block Diagram of PROCESSING UNIT (59W85)

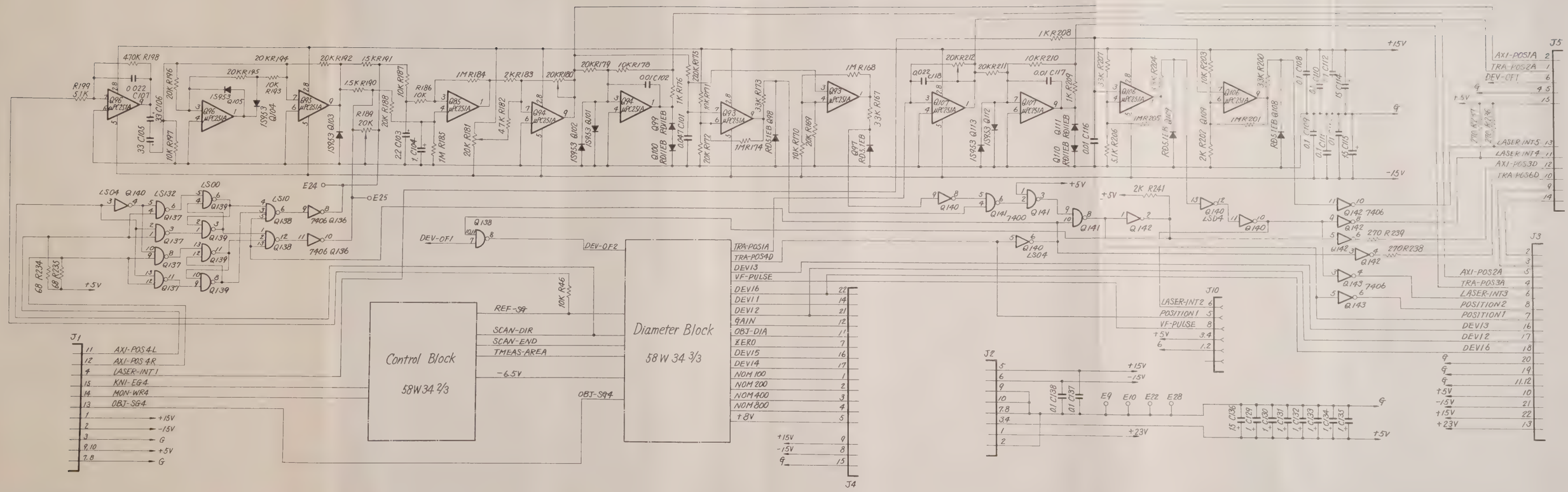


Fig. 5-4 1/3 PROCESSING UNIT U1 Output Circuit (58W34 1/3)

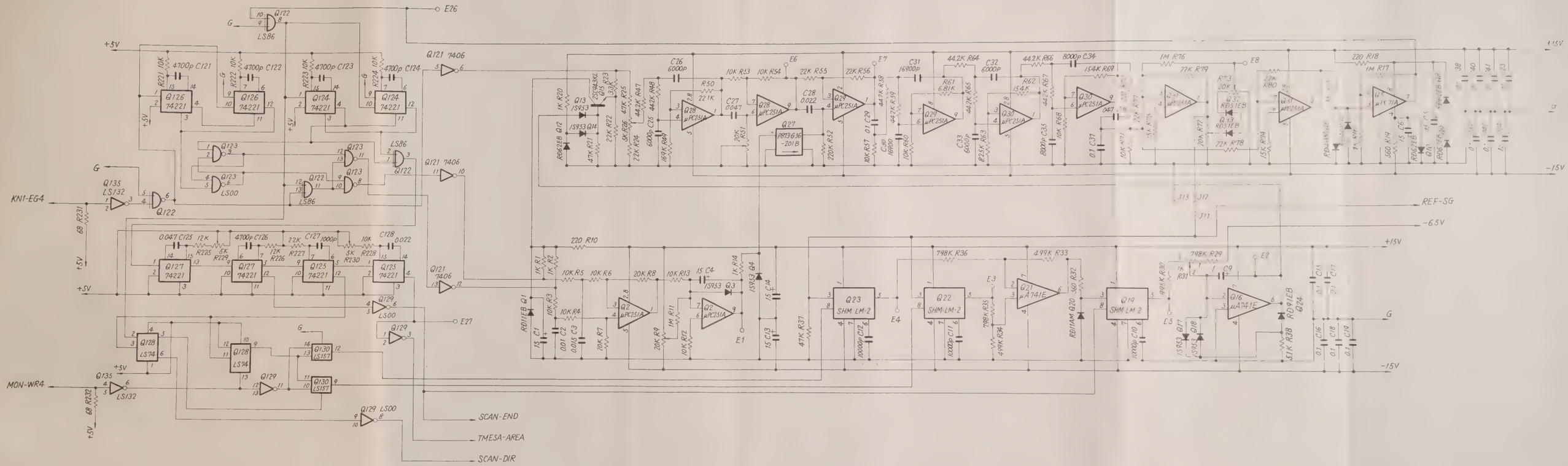


Fig. 5-4 2/3 PROCESSING UNIT U1 Output Circuit (58W34 2/3)

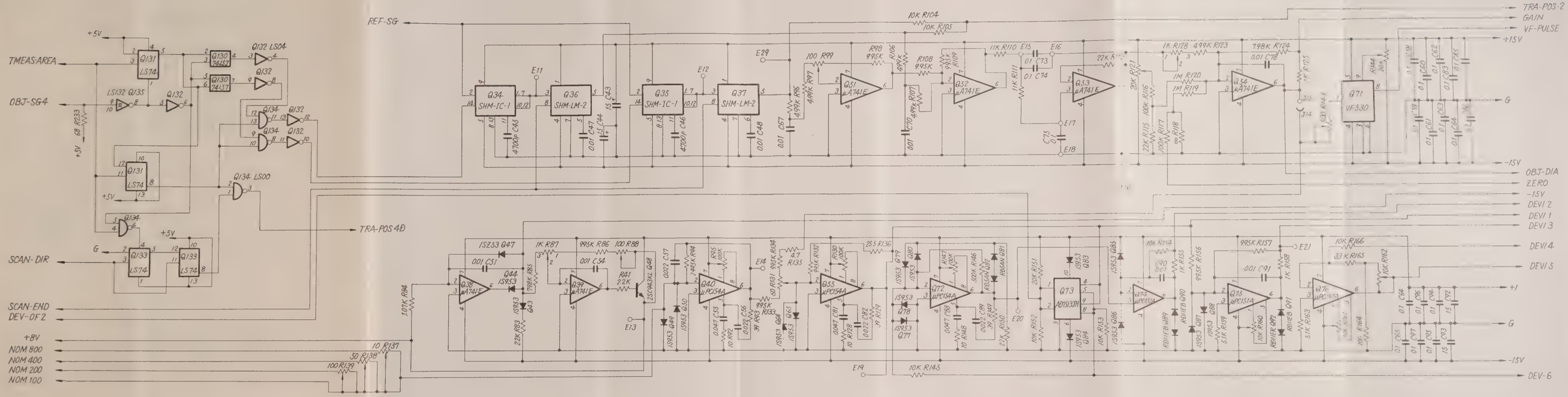


Fig. 5-4 3/3 PROCESSING UNIT U1 Output Circuit (58W34 3/3)

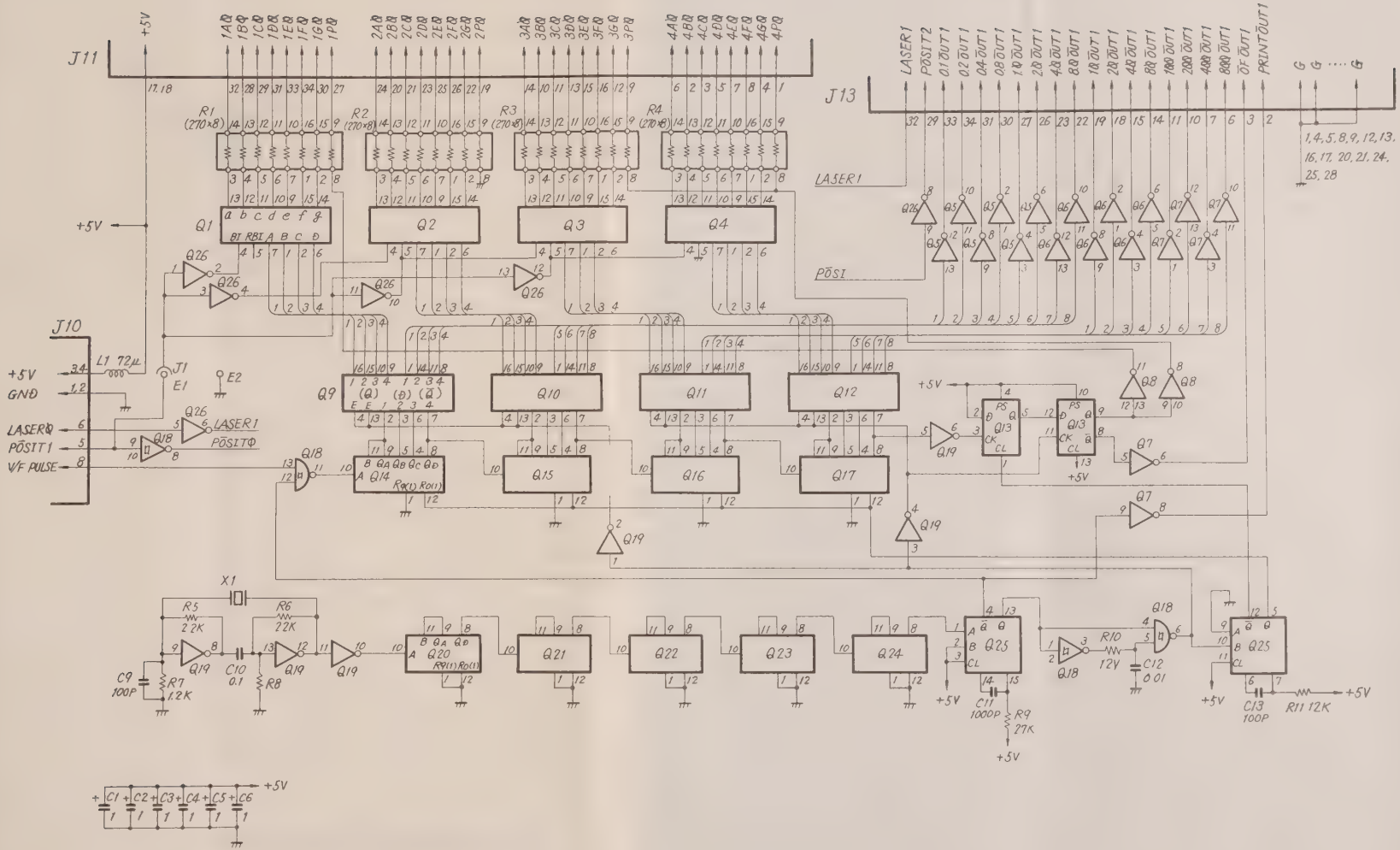


Fig. 5-5 PROCESSING UNIT U2 Counter Circuit (53W4099)

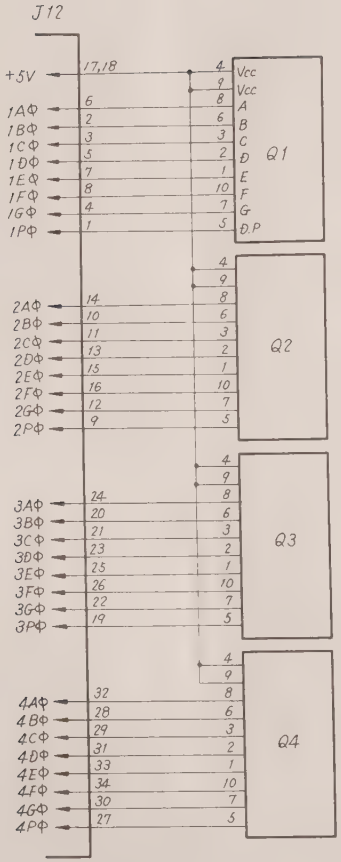


Fig. 5-6 PROCESSING UNIT U3 Display Circuit (54W13717)

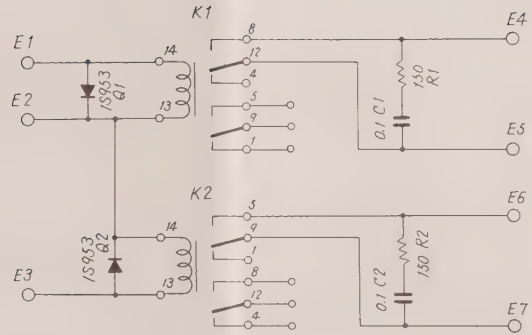
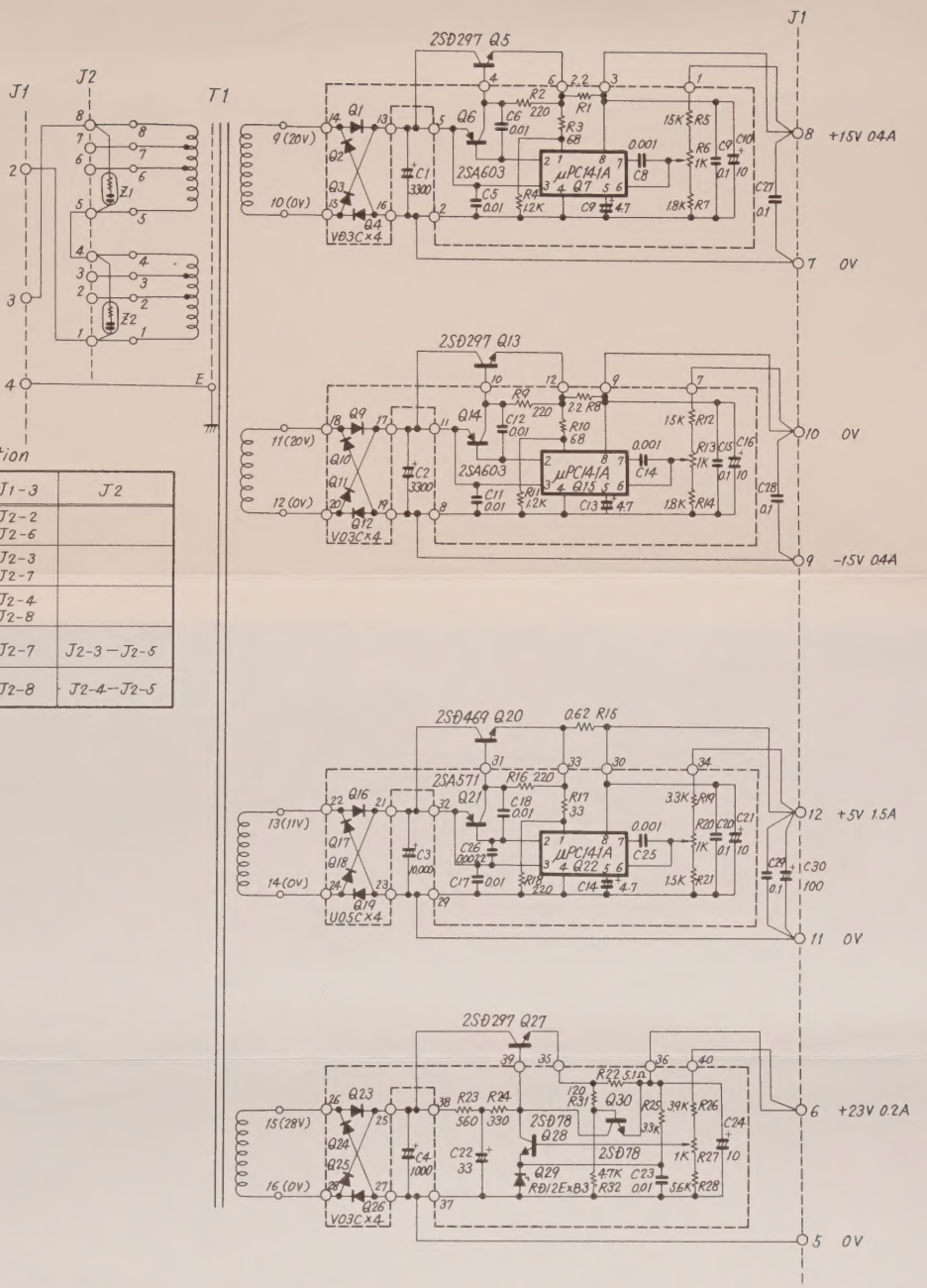


Fig.5-7 PROCESSING UNIT U4 Relay Circuit (54W13747)



$J_1 - J_2$ Connection

Input Voltage	J1-2	J1-3	J2
AC 100V	J2-1 J2-5	J2-2 J2-6	
AC 115V	J2-1 J2-5	J2-3 J2-7	
AC 120V	J2-1 J2-5	J2-4 J2-8	
AC 220V	J2-1	J2-7	J2-3 — J2-5
AC 240V	J2-1	J2-8	J2-4 — J2-5

Fig. 5-8 PROCESSING UNIT Z2 Power Supply (53W4340)

MP MASTER
MA35796